Railway Mechanical Engineer

Name Registered U. S. Patent Office

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic.

Editorial Contents for August, 1929

Volume 103 *No. 8*

Published on the first Thursday of every month by the Simmons-Boardman Publishing Company, 34 North Crystal Street, East Stroudsburg, Pa., and 30 Church Street, New York

SIMMONS-BOARDMAN PUBLISHING COMPANY, 30 CHURCH STREET, NEW YORK

Publishers also of Railway Age, Railway Engineering and Maintenance, Railway Electrical Engineer, Railway Signaling, Airway Age, Marine Engineering and Shipping Age, The Boilermaker, Locomotive Cyclopedia, Car Builder's Cyclopedia, and Railway Engineering and Maintenance Cyclopedia

Chicago: 105 West Adams St. Cleveland: Terminal Tower Washington: 17th and H. Sts., N. W. San Francisco: 215 Market Street.

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Subscriptions, including the eight daily editions of the Railway Age published in June, in connection with the annual convention of the American Railway Association, Mechanical Division, payable in advance and postage free: United States, Canada and Mexico, $3.00 a year; foreign countries, not including daily editions of the Railway Age, $4.00.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulation (A. B. C.)

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Do You Like It?

IN this issue of the *Railway Mechanical Engineer* we have made a change in the make-up of the paper which is a departure from the practice we have observed for many years in all regular issues of the paper. We refer to the dropping of the "Car Department" and "Shop Practice" department heads. This has been done for the sole purpose of improving the general appearance of the paper and, we hope, of making it more attractive to our readers. Under the new practice there will be no change whatever in the balance of material dealing with subjects of interest to supervisors in the locomotive and car departments, to general officers of the mechanical department, and to officers interested in equipment design and operation. We shall exercise the same care in supplying both the feature articles and the shorter articles dealing with details of practice formerly grouped under the "Car Department" and "Shop Practice" heads as we have in the past. We are making the change in the belief that our readers will have no difficulty in finding the articles in which they are particularly interested and in the belief that the interests of many of our readers are becoming less narrowly confined to the subjects with which they have to deal specifically, but are broadening to include some interest in everything which has to do with equipment of all classes and the problems of organization involved in its maintenance. If we have misinterpreted your interests and you do not find the change in make-up pleasing, we hope that you will tell us so frankly. If after a fair trial you do not like the new arrangement we shall cheerfully restore the old one.

Opportunities to Improve Methods

WITHOUT doubt a major portion of the attention which has been devoted to the improvement of equipment-maintenance methods during the past few years has been directed toward locomotive shop methods and facilities and the substantial savings which have been effected have more than justified the effort. A substantial part of the reduction in the cost of locomotive repairs may be attributed to the installation of modern shop facilities. Except for the gradual refinement of shop scheduling systems, there has been no radical change in the general methods of overhauling locomotives in the back shop during the last ten years. It seems logical to expect, therefore, that any material reduction in locomotive repair costs in the future must be brought about as a result of the refinement of individual operations and the further installation of modern shop equipment to replace that which is obsolete or inadequate to meet production requirements. This opinion is ventured only in view of conditions as they exist on most roads today and does not attempt to take into consideration the possibilities of reduced maintenance costs as a result of the concentration of repair facilities incident to the consolidation of properties.

In viewing the accomplishments of the car department during the same period we look upon an entirely different picture, at least in respect to freight-car repairs, for here we see that there has taken place a radical change in the general method of making heavy repairs to freight equipment—the reference is to the introduction of the progressive system—and that the change has resulted in very substantial reductions in the cost of maintaining equipment. Just how substantial these savings may have been in individual cases may be seen from the experience of one road having about 65,000 freight cars, which, by a change of methods at one large shop repairing over 800 cars a month, effected a 45 per cent reduction in the cost of wood car repairs in one year while at the same time the output of the shop was doubled and the force was reduced by eight per cent.

The important point to be considered in viewing the relative accomplishments of the locomotive and the car departments is that the car department has made its savings almost entirely by the development of new methods of performing repair work and that it has not fared equally well with other departments in the matter of new facilities. In the latter respect seems to lie the real opportunity for future economies in car maintenance.

The average car shop, with the exception of the large fabricating shop, usually leaves a lot to be desired when it comes to modern shop equipment. There are two important classes of equipment for the car shop which warrant careful and elaborate study—metal-working and fabricating tools and material-handling equipment, both of the overhead type and the portable truck or crane type. In the matter of machine-tool equipment an inspection of many freight-car shops will disclose an abundance of home-made air operated machines for forming and shaping car parts not to mention pneumatic lifting devices made in the shop without any thought of economy in air consumption. The replace-

ment of this equipment will result not only in economy in the operating cost of the devices but in an additional saving as a result of increased productive capacity.

One of the greatest opportunities for savings in freight-car repair work seems to be in the matter of material-handling methods and equipment. Since the introduction of the progressive system of car repairs the problem of handling material has increased in importance. The prompt delivery of material required in the repair operations is of vital necessity in passing the cars through the various positions in the repair line on schedule time, and the efficient handling of repair parts at the different positions offers the opportunity to cut the man-hours required on a car at each position, either in reduced handling time or reduced force.

Car department supervisors are to be commended for what they have accomplished in effecting reductions in repair costs with a minimum of investment for new facilities. It is possible, however, that with the experience derived in developing new methods a part of the potential savings have been overlooked by a failure on their part to give more study to the question of modernizing shop facilities.

Experimental Steam Locomotives

THE orders placed in May by the New York Central and the Canadian Pacific for high-pressure, double-pressure steam locomotives, the basic boiler designs of which are similar to the Schmidt locomotive built for the German State Railways in 1925, and also in order placed last month by Timken for an experimental 4-8-4 type locomotive on which all of the axle journals are to be equipped with roller bearings, have added considerable of interest for railroad men who are following the efforts that are being made by both the railroads and the builders to improve the steam locomotive. At the present time there are seven locomotives of the Schmidt double-pressure design in operation or on order. In addition to the two locomotives ordered by the Canadian Pacific and the New York Central, orders have been placed by the Paris, Lyons & Mediterranean (France) and the London, Midland & Scottish (Great Britain), and orders for two more, in addition to the locomotive already in operation, have been placed by the German State Railways.

The High-Pressure, Double-Pressure Locomotive

The Canadian Pacific is constructing its double-pressure locomotive at its Angus shops, with the co-operation of the Montreal Locomotive Works and the Superheater Company. The New York Central double-pressure locomotive is being built by the American Locomotive Company, also with the co-operation of the Superheater Company. Both locomotives are being built for experimental service, and likewise in both designs the indirect method of steam generation will be used in the high-pressure portion of the boiler.

The three locomotives on order by the Paris, Lyons & Mediterranean and the German State Railways are being built by Henschel & Sohn, Cassel, Germany, and the Schmidt Superheater Company, the same firms that built the original Schmidt double-pressure locomotive. These locomotives are to carry somewhat higher steam pressures than the one already in service in Germany and those on order on this continent and in England. The L. M. & S. locomotive is being built jointly by the North British Locomotive Company and the Superheater Company, Ltd.

Locomotive Experimental Work in Great Britain and Europe

This is the fourth important attempt in the line of experimental development on the part of British locomotive builders and railroads to produce a locomotive of what might be termed "novel construction." The first two were turbine locomotives; namely, the Ljungstrom locomotive and the Ramsay turbine-electric locomotive. The third attempt was the Kitson-Still locomotive which was built in 1927 for the London & North Eastern by Kitson & Co. This locomotive is equipped with a double-acting engine, with internal combustion operation at one end of the cylinder and steam at the opposite or piston end. A description of this locomotive was published in the July, 1927, issue of the *Railway Mechanical Engineer*, page 436.

Much of the experimental development work in Europe has been undertaken with the primary object of conserving fuel, which is more expensive there than in North America. As a result, attention has been given primarily to improving the steam locomotive boiler and developing Diesel locomotives. It is interesting to note in this connection that a number of American engineers who have been in Europe in recent months, report that designing engineers abroad are now favoring electric drive in preference to mechanical and hydraulic drives.

Undoubtedly Germany has been the most aggressive in developing new locomotive designs. In addition to the Schmidt design, the German State Railways ordered a high-pressure locomotive equipped with the Loeffler system from the Berliner Maschinenbauanstalt, Berlin-Wildau, which was scheduled to be delivered in July of this year. The design of this locomotive was developed as the result of favorable experiences with the Loeffler steam pumping system in stationary plants in Vienna, Austria, and Witkowitz, Germany. It develops 2,500 hp. and operates at a pressure of 1,760 lb. at a temperature of 950 deg. F. It is estimated that about 50 per cent saving in fuel and water will be obtained with this design. Another interesting development in Germany is the pulverized fuel burning locomotives built by the Allgemeine Elektrictats Gesellschaft for the German State Railways. It is reported that there are now three of these locomotives in service, the last one being delivered the first part of this year.

The Swiss Locomotive & Machine Works, Winterthur, Switzerland, has been experimenting with a locomotive since 1927, which operates at a pressure of 875 lb. A number of unique features have been incorporated in the design of this locomotive, such as a water-tube boiler, jack shaft and gear transmission, and a piston-operated valve gear. The gear transmission from the cylinders permits connecting the main rods direct to the front pair of drivers.

The Turbine Locomotive

Ljungstroms in Sweden have been the most aggressive in the development of the turbine locomotive. At the present time there are three locomotives of Ljungstrom design in operation on the Swedish State Railways, one in England, and one in Argentine. The recent order placed by an ore mining company in Sweden with the Aktiebolaget Ljungstroms Angturbine for two non-condensing turbine locomotives is of considerable interest. These locomotives are to be practically of the same design as the Ljungstrom condensing locomotives that have been described at various times in these columns, except that the condenser is to be omitted. No recent reports of tests of the Zoelly turbine locomotives built by Escher

Wyss & Company, Zurich, Switzerland, and the Krupp Works, Essen, Germany, in 1924 and 1925 respectively, have been published.

Experimental work in this country, compared with some of the locomotive construction that has been undertaken in Europe, has been along somewhat more conservative lines. American locomotive designers appear to favor the conventional type of locomotive boiler, and it can be said that they have accomplished much in the way of its improvement. Departures from the conventional have been made in the Baldwin No. 60,000, the "Horatio Allen" and the "John B. Jervis" of the Delaware & Hudson. It is reported that this road is contemplating the construction of an addition to its series of experimental designs—a locomotive which will operate at a pressure between 450 and 500 lb.

To attempt to predict the "locomotive of the future" from the various lines of attack that are being made both at home and abroad would be exceedingly difficult. The fact that the more radical developments are taking place in Europe does not mean that the American locomotive designer is not as daring in his ideas and as skillful as locomotive designers abroad. Economic considerations have been the primary cause for endeavors to improve the steam locomotive the world over. Operating conditions peculiar to the country have much to do with the type of locomotive that a railroad uses, and in all probability these conditions will be the principal factors in determining the locomotive of the future. The demand for increased unit capacity has long been the primary motive behind the development of the locomotive in America, while fuel economy has taken precedence in Europe. It is only within recent years that fuel economy, entirely aside from its relation to capacity, has become an important factor in American locomotive developments.

Where Does the College Man Come In?

ON the Reader's Page of last month's issue are two letters commenting on an editorial in the April issue entitled "Is There a Future with the Railroads," which discuss this question as it applies to the future of college-trained men in the mechanical departments of the steam railways. One of these letters calls attention to the apparent lack of interest on the part of the railroads and the effect it is having on those colleges which have devoted particular attention to the preparation of mechanical engineering graduates for railway service, and the other points out with unusual clarity a phase of the psychology of the young college graduate which is likely to cause him to avoid railway service.

The relations of the college man with the railroads have been the subject of discussion in these columns many times during the past ten or fifteen years, and what will be the ultimate adjustment of these relations is little clearer today than it was fifteen years ago. There was a time when the special apprenticeship course, modeled somewhat after that in vogue in some of the larger production industries, seemed to offer the answer. While such courses undoubtedly have their place today, they have by no means offered a complete solution of the problem. One of the fundamental weaknesses of apprenticeship courses designed to induct college men into the line organization is the discrimination against non-college trained men which they imply. It makes little difference whether this discrimination is real or merely inferred by the special apprentice himself. In the first instance the result has a bad reaction on the lower grades of supervisors and on the ranks from which these supervisors are promoted. In the second instance the failure to make good on an implied promise of advancement leads to disappointment on the part of the apprentice.

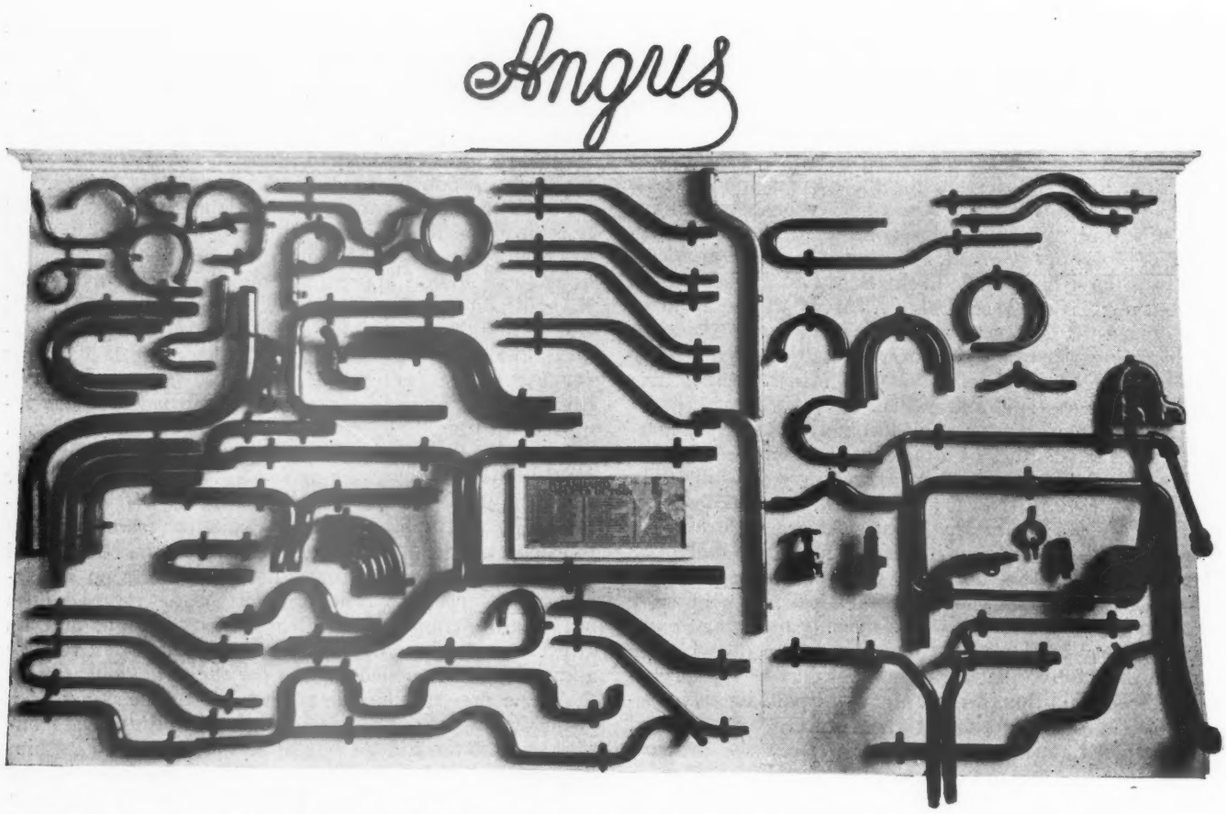
There is one important difference between the railroads and many production industries which has a basic effect on their attitude towards specially-trained personnel, and it is probable that a failure to recognize this difference has been responsible for some of the disappointing results of railway special apprentice courses. The function of the railroad is one of conducting a rather complicated and constantly more highly specialized series of non-technical operations, rather than the development of machines for use in the performance of those operations. For this reason a minimum number of railroad men are required with highly specialized preparatory training, such as may be required for the control of some highly technical industrial processes or for the engineering of new products, while by far the greater number of railroad supervisors and officers must acquire a training from thorough practical experience, starting at the bottom and working their way up through the organization as circumstances permit. The product of the railroad does not require engineering talent for its design, and its direct operations, while highly specialized, do not require a knowledge of applied science for their control.

At the present time we seem to be in the midst of a swing away from the idea of giving any special consideration to the college man as an inducement to get him into the railroad organization. This swing may extend to an unreasonable extreme. Its effect, so far, has been to eliminate special apprenticeship from consideration, except to the limited extent required for recruiting specially-trained men for engineering staff positions.

Beyond the need for these few trained specialists, there would seem to be little reason why the railroads should hold out to engineering graduates any special inducement for coming into the organization, where the future of all but a relatively small number of individuals must lie in the line organization. While engineering training may be indirectly beneficial to the line officer, his duties are of such a nature that he cannot directly exercise his professional knowledge in their conduct. A strong personality and keen intellect are of greater importance in handling men and dealing with the practical problems of the shop and enginehouse than is any particular type of preliminary mental training.

On the other hand, there can be no doubt but that the future problems of the mechanical department officer and supervisor will be such that the railroads will profit by having the services of men of the broad vision which a thorough intellectual training tends to develop. But to be a successful railroad man, one must be far more interested in railroading as a business than in engineering as a profession.

Just what line the future adjustments may take to bring men of such training into the railroad organization, without special inducements which penalize their co-workers who have been less fortunate in the matter of preliminary training, it is difficult to say. It may well be a modification of the conditions under which the supervisors of foreman rank have to work which will make their jobs as attractive as similar jobs in any other industry. Are there really any important reasons why foremen in railroad shops and engine terminals should have to endure the hardships of long hours and little leisure for the enjoyment of life or for self improvement when these hardships have been removed from the men whose work they supervise?



Sample board showing some of the bends made at the Canadian Pacific pipe shop located at the Angus, Montreal shops

Passenger Car Heating and Plumbing

Work in Canadian Pacific Angus shops planned to reduce labor and material costs—Templates and jigs used for bending and preassembling pipe

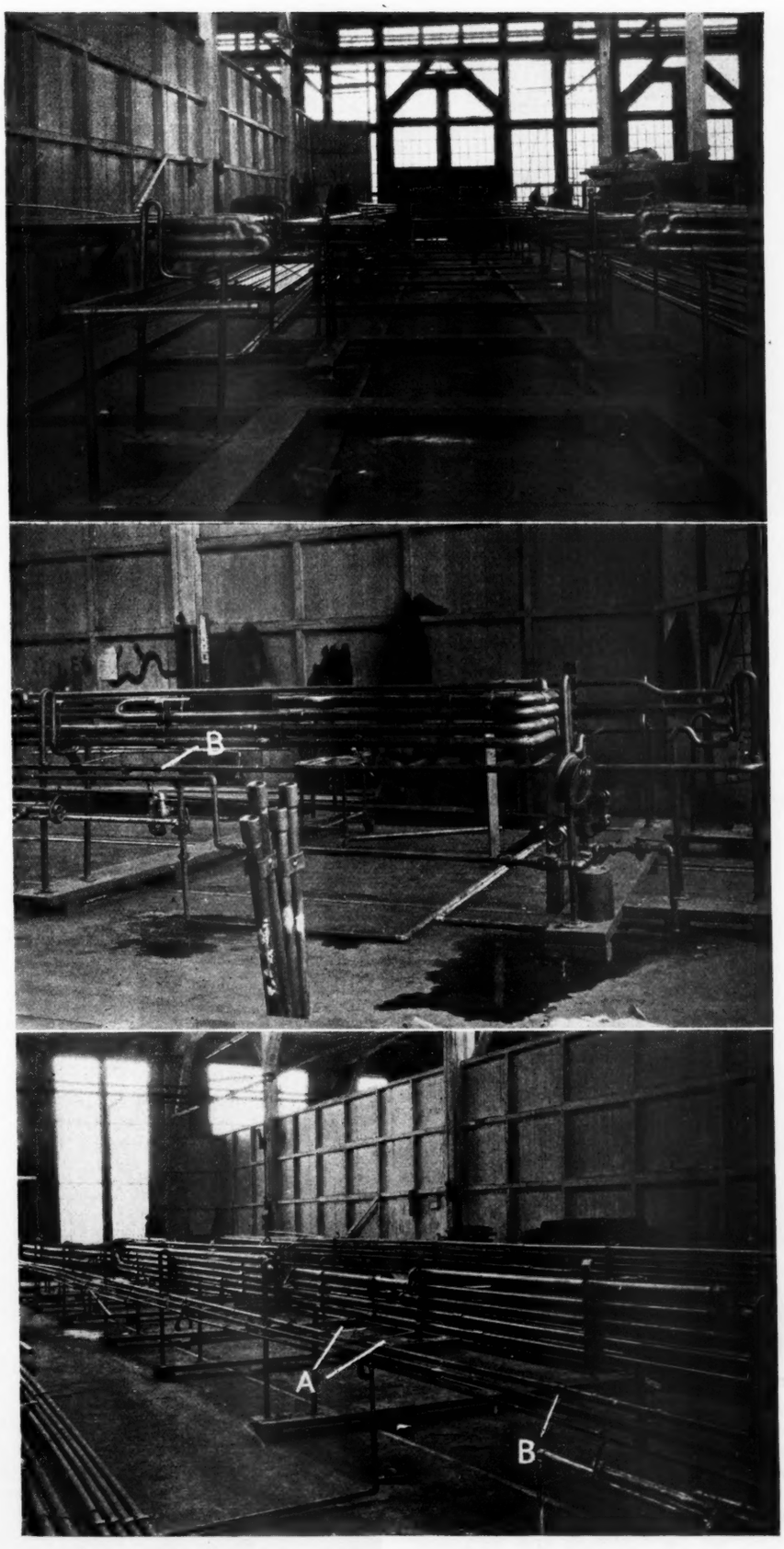
A LARGE passenger car repair shop is one of the units that comprises the Angus, Montreal, locomotive and car repair shops of the Canadian Pacific. Piping and plumbing constitute one of the major items of work on passenger cars when shopped for a class repair. Because of the large number of cars handled in this shop, special attention has been directed toward the organization and equipment of the pipe shop with the objective of reducing labor and material costs. As a consequence, many unusual methods, shop facilities, jigs and fixtures are used in this shop which are uncommon to many pipe shops.

The pipe shop, which is located in close proximity to the passenger car repair shop, is laid out and equipped to facilitate the manufacture and repair of pipe and fittings for plumbing work. Pipe of various sizes and lengths is unloaded from cars directly into a storeroom adjoining the pipe shop. As shown in one of the illustrations, the pipe is stored in metal racks, the ends of which face the double window through which the pipe is passed into the shop when needed. In front of the window are two pairs of supports made of pipe on which the stored pipe is slid into the shop. This arrangement reduces to a minimum the time and labor required for handling pipe from the car into the pipe shop for usage.

The machines used for cutting-off and threading pipe and for the manufacture of various pipe fittings are grouped in one corner of the shop. Cutting-off a piece from a standard length of pipe is usually accompanied with considerable noise caused by the rapidly whirling of the long loose end of the pipe. This noise has been eliminated by the anti-rattle rack shown in one of the illustrations, which consists of a wooden trough lined inside with carpet to deaden the sound of the revolving pipe. It can be adjusted to the height of any pipe cutter and furthermore is portable. The same illustration also shows a rack—made from pipe—

used for holding long and short lengths of pipe. The rack for holding short pieces of pipe consists of a section of sheet steel semi-circular in form, supported by the crimped edges hung over two lengths of parallel pipe spaced about 3 ft. apart. This arrangement keeps the pipe up from off the floor.

Since many small pipe fittings are made in this shop, a handy three-legged wagon, similar to the one shown in the illustration, has been built for transporting the fittings about the shop. It consists of a welded sheet-metal receptacle supported on a frame made of bent pipe and fittings. As an example of how these wagons are used, one of them is placed at the cutting-off machine to receive the pieces of pipe, after which it is moved to the reaming machine where the pipe is placed into a second wagon after the reaming operation is completed. This wagon is then moved to the pipe-threading machine where the finished pipe is thrown into a third wagon. These wagons have saved considerable time and labor in the handling of small pieces of pipe.



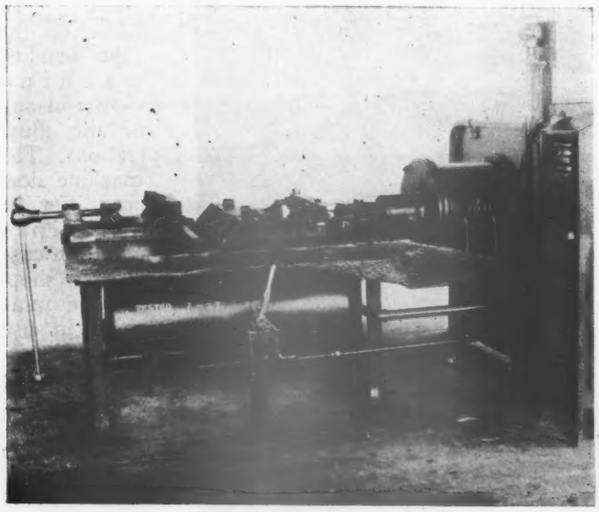
Interior piping for passenger cars is assembled and tested as a unit on this rack after which it is carried by a gang of men into the car

Connecting up pipes on a passenger car is often a difficult job because of the limited space in which to manipulate the pipe wrenches. In order to eliminate as many pipe connections as possible, a highly developed system of bending pipe has been worked out in this shop. All of the cold bends are made on the pipe bending machine shown in one of the illustrations. The machine does not differ in principle from the customary shop-made machine in use in many railroad shops; however, there are several features that are of unusual interest. Rollers are used instead of dies because they eliminate the possibility of kinks in the bend since the pipe slides in the rollers. Also the pis-

Anti-rattle device used with pipe cutting-off machine

ton of the air-brake cylinder travels at a constant speed, which is controlled by a straight-air valve so arranged by a stop that only a certain amount of air is allowed to pass into the cylinder. The operator must hold the control valve in the open position for as soon as he removes his hand, a spring pulls the valve handle into the closed position. The purpose of this arrangement is obvious. Various degrees of bends are obtained by the simple adjustment of the two arms in which the rollers are held.

By the use of this machine, a large number of standard bends have been worked out to eliminate fittings and connections. Samples of these bends have been mounted on a board and given a number. A wire



Pipe bending machine on which rollers instead of dies are used

template has been made for each bend and these templates are kept in the toolroom. Thus, if a pipe fitter has to make a bend with which he is not familiar, he refers to the board, gets the number of the bend, secures the template from the toolroom and then proceeds to make the bend to fit the template.

If a change has been made in the piping of a car that requires new bends, the bends are laid out on the floor from the drawings from which templates are made. The illustration showing the various types of pipe bends made in this shop indicates that no bend is too difficult to make.

All hot bends are made in the vise type of pipe bender shown on the end of the table of the pipe bending machine. The pipes are filled with sand, heated and clamped in the vise in a horizontal position which

Handy three-wheeled wagon used for small pieces of pipe

obviates the necessity of bending the pipe upward, thus eliminating kinks in the bend.

How the Inside Piping Is Assembled for a Car

Carpenters, electricians, tinsmiths and pipemen are usually found working together inside of a passenger car during the finishing operations. The result is that the men get in each others way because of the limited space, material lying about and the necessity, for instance, of replacing piping and electrical conduits at the same time. The pipe gang is particularly bothersome because of the long pieces of pipe it has to install, the handling of which interferes with the other workmen.

Considerable of this confusion and lost time has been eliminated by assembling the piping for a car on a combination assembling jig and test rack, shown in one of the illustrations. The jig is made up of eight sections, each

Pipe storage room which opens directly into the pipe shop

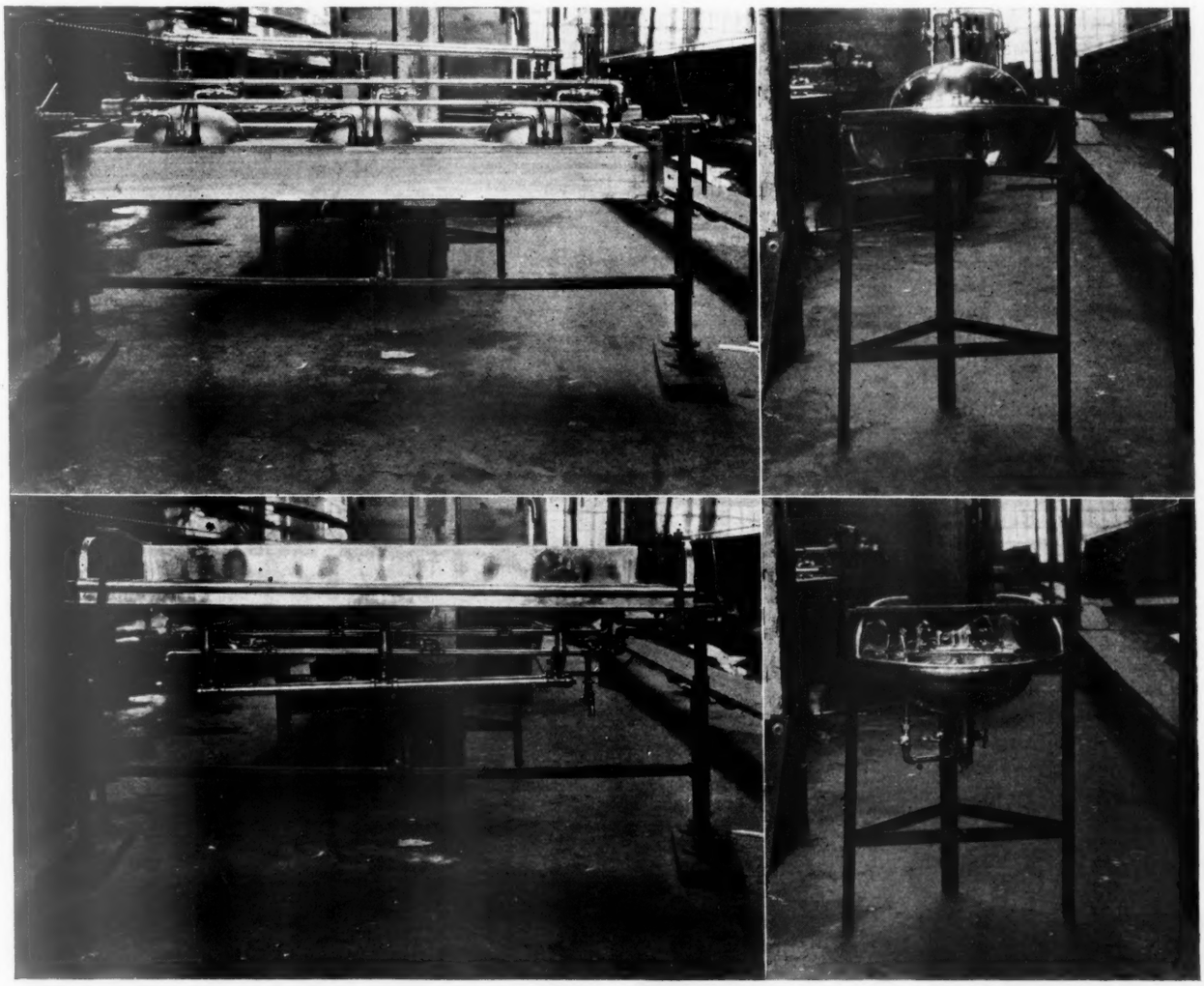
consisting of a wood base, on which is mounted a rack made of pipe. These racks, which are adjustable, support the pipe as it is being assembled. The whole jig is tied together by pipes for air, steam and water, which are used for testing purposes. As may be seen from the illustration, tee pipe fittings are connected into the outside leg of the adjustable frames, thus permitting each frame to be slid along the steam-testing pipe and at the same time helping to support the three pipes already referred to. Metal pointers *A* and clamps *B*, painted red, are mounted on the top test pipe. The former are used to indicate car partitions and the latter indicate where the pipe clips are to be placed on the assembly. These clips are so located that they will not interfere with the pipe couplings.

Since most of the Canadian Pacific passenger cars are equipped with a dual hot water and vapor system, the assembled piping is tested at 300-lb. water pressure and 100-lb. steam pressure. Air pressure can be applied when necessary.

The rack is used in the following manner: As far as practical, a certain series of passenger cars are built in the shop at the same time. This enables the pipe shop to keep on hand a supply of pipe already bent ready for assembly. When a car is ready for piping, the workmen secure the piping arrangement drawings and proceed to assemble the pipe on the rack according to the drawings. After the piping has been assembled and tested, it is picked up as a unit by a gang of men and carried into the car. It then requires only four hours for four pipe fitters and four helpers to couple up and clip the pipe in the car ready for the bulkheads. By the old method of assembling the pipe in the car, about five days would be required to do this work.

The piping and fixtures must be assembled on wash basins after they are received from the renovating department. The basins, owing to their shape, are awkward to handle on a bench where the work is usually done. One of the illustrations shows a jig in which single and multiple wash basins are held while the piping and fixtures are being applied. The fixture for holding a single wash basin consists of three angle-iron legs held together at the bottom by a flat strip of metal bent triangular in shape and at the top by the frame in which the basin fits. The basin is held in place by a rubber-covered iron rod.

The jig for holding multiple basins consists of a framework of iron pipe, each end of which is attached to wooden boards, which rest on the floor. The basin is placed on two metal strips bolted to wood and held securely in place by two iron clamps, which rest on



Method of using stands in which to assemble the fittings on wash basins

wooden blocks so as not to mar the nickel finish. A locking device is located at the top of each leg of the jig. Thus, when the basin is clamped in position, the top or bottom can be worked on by loosening the clamps and swinging the basin around. The basins are also water tested for leaks before they are removed from the jig. By using these jigs, the fittings can be quickly assembled at any car in the shop.

Repairs to passenger car hoppers are made in a room separate from the pipe shop and located in the main building. Because of the weight and peculiar shape of the hoppers, the repair shop has been especially equipped and laid out to facilitate repairs. The repair benches, testing rack and the storage bins have all been made the same height to conform with that of the three-wheeled carriages on which the hoppers are moved about the shop. The construction of these carriages is clearly shown in one of the illustrations. When in service the carriage is placed against the bench on which sets the hopper, thus making it an easy matter to place or remove the hopper from it. This carriage saves considerable manual labor and expedites repairs.

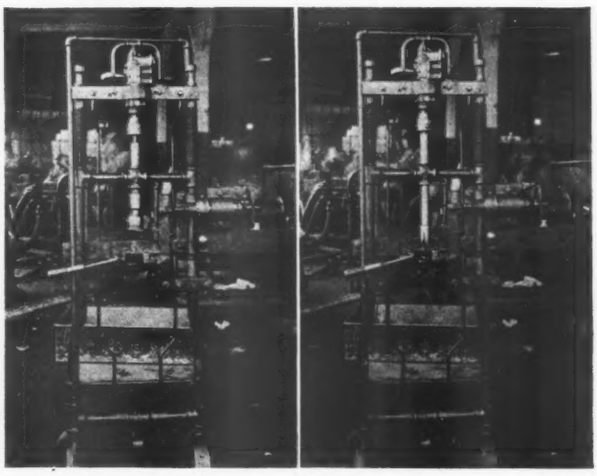
After the hoppers have been repaired, they are tested for leaks and timing on the rack shown in the illustration. As will be noted, the rack may hold four hoppers for testing at one time, three of the air-operated type and one of the gravity type.

Hopper testing rack and a three-wheeled carriage for moving them about the shop

Steam-Heat Repair Devices

Passenger car steam-heat equipment, such as the hose and the vapor-heat control valves, are repaired and tested in the pipe shop. Standard practice is followed in making repairs, but some of the shop-built devices used in connection with the work are original in design.

Of particular interest is a portable three-wheeled steam-hose gasket cleaning machine. As shown in the illustration, it consists of a pipe frame supported on three wheels. The front part of the frame has an air motor which drives a spindle and another air motor which operates the clamps which hold the work. Two spindles are used in the machine, one for polishing the valve seat in the hose and the other for polishing the valve. The former spindle contains a universal joint at its lower end in which is held a polishing tool, rounded on its end and to which is attached a soft piece of rubber. The hose is held in the air-operated jaws controlled by a two-way valve. The frame on which is mounted the spindle and motor is moved up and down against two springs by a foot treadle. Thus, the valve seat can be quickly polished by a pounding-in action.



Machine used for cleaning steam-hose gaskets and seats

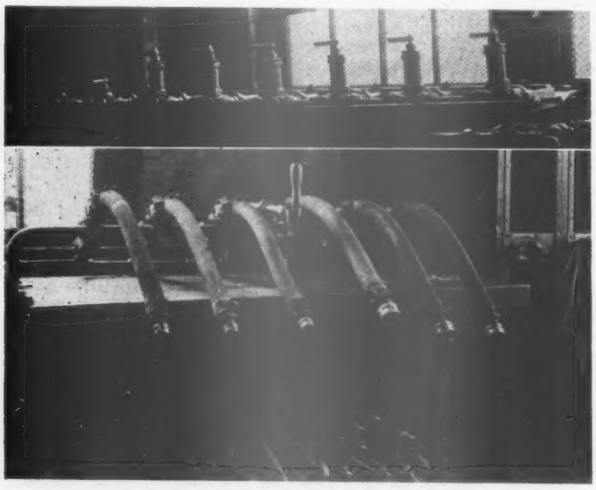
The method of cleaning the valves differs somewhat. A block of wood, on which is fastened emery cloth, is held between the air-operated jaws while the valve is held in a special fixture attached to the end of the spindle. It is a simple matter with this arrangement to polish the sides and bottom of the valve.

Two shelves for the storage of material are built onto the rear of the machine which can be moved to any place in the pipe shop or to any car in the repair shop.

One of the illustrations shows a rack for testing vapor heat control valves and another a rack for testing hose. The former is piped and arranged for testing.

Steam is used as a testing medium, passing through a regulator, which reduces it to atmospheric pressure, so that the valves receive the same test as when in operation on the cars. The valves are first tested in the closed position for leaking through and then each valve is opened to test out circulation.

A feature of the hose test rack is that only one control handle is required to test six hose at one time. One end of the hose is capped and the other end is attached to the test rack. By operating a two-way valve, pressure can be applied simultaneously to all hose.



Racks on which are tested vapor heat control valves and car hose

Examples of Recent Freight Locomotives of the 2-10-0, 2-10-2 and 2-10-4 Types

General Dimensions, Weights and Proportions

Type	2-10-0	2-10-0	2-10-0	2-10-2	2-10-2	2-10-2	2-10-2	2-10-2	2-10-2	2-10-2	2-10-2	2-10-2	2-10-2	2-10-2	2-10-4	2-10-4	2-10-4
Railroad	Penna.	L. & N. E.	W. M.	U. S. R. A.	U. S. R. A.	C. & I. M.	A. C. L.	So. Pac.	C. of Ga.	C. R. I. & P.	Can. Nat.	A. T. & S. F.	Mo. Pac.	Rdg.	B. & O.	C. V.	T. & P.	C. B. & Q.
Road class	I-1-s	.....	I-2	Light	Heavy	.....	Q-1	F-5	C T	N78	T-2a	3800	SF	K-1-sa	S-1-a	T-3a	I-1c	M-4
Road number	4300	402	1112	2102-A	2102-B	600	2007	3754	704	3030	4100	3920	1729	3001	6206	702	640	6312
Builder	Bald.	Bald.	Bald.	A. & B.	A. & B.	Bald.	Bald.	Bald.	Bald.	Amer.	Can.	Bald.	Bald.	R. R.	Bald.	Amer.	Lima	Bald.
Date built	1923	1927	1927	1918	1918	1927	1925	1924	1925	1925	1924	1927	1926	1928	1926	1928	1928	1927
Tractive force, engine, lb.	90,024	90,000	90,000	69,400	74,000	69,500	75,700	75,150	73,830	77,800	80,200	85,360	81,500	90,500	84,260	76,800	84,600	90,000
Tractive force, booster or aux. loco., lb.	.....	.....	.....	.....	.....	11,500	.....	10,800	.....	.....	11,535	13,640	.....	.....	.....	13,100	13,300	.....
Cylinder horsepower (Cole)	.....	3.649	3,649	2,624	3,082	2,624	3,163	3,136	3,082	3,244	3,030	3,568	3,406	3,688	3,568	3,280	3,860	4,320
Piston speed at 10 m.p.h.	289.2	293.8	293.8	314.5	284.5	314.5	284.5	282.2	284.5	284.5	314.5	284.5	284.5	291.5	280.0	298.7	284.5	280.0
Engine and Tender Data																		
Weight of engine, lb.	386,100	399,200	419,280	352,000	380,000	363,550	391,980	397,900	401,480	405,000	409,240	413,500	420,650	439,900	440,340	419,000	452,000	512,110
Weight on drivers, lb.	352,500	364,000	386,800	274,000	293,000	276,860	303,060	306,100	309,220	317,500	321,780	320,000	326,080	353,050	346,350	285,000	303,000	353,820
Weight on front truck, lb.	33,600	35,200	32,480	23,500	28,500	23,040	27,120	31,200	30,270	27,000	28,780	31,000	30,730	31,075	34,180	35,000	42,800	47,920
Weight on trailing truck, lb.	.....	.....	.....	54,500	58,500	63,650	61,800	60,600	61,990	60,500	58,680	62,500	63,840	55,775	59,810	99,000	106,200	110,370
Weight of tender, loaded, lb.	204,700	212,700	415,920	188,300	206,100	185,850	221,020	239,600	208,020	223,600	245,800	288,600	239,900	228,160	294,900	269,600	276,700	385,790
Tender, water capacity, gal.	10,300	12,000	22,000	10,000	12,000	10,000	12,000	12,000	12,000	12,000	13,200	15,000	12,000	12,000	15,800	13,500	14,000	21,500
Tender, fuel capacity, tons or gal.	18¾	16	30	16	16	16	16	4,000	16	18	16	5,000	16	18	23	20	5,000	24
Wheel base, driving, ft. and in.	22—8	22—6	22—6	21—0	22—4	21—0	22—10	22—10	22—4	22—6	21—8	22—0	22—6	22—0	22—4	22—0	22—0	22—4
Wheel base, engine, ft. and in.	32—2	32—10	32—10	40—4	42—2	40—4	42—9	42—4	42—6	42—7	42—2	41—1	42—7	42—1	42—11	44—2	46—8	45—6
Wheel base, engine and tender, ft. and in.	73—4½	77—10¾	92—9½	75—11½	82—10½	75—11½	83—0½	84—1½	82—5	82—8	80—9¾	85—6⅛	83—6½	84—5	89—10⅞	82—2¼	86—8	95—11¼
Cylinders, diameter and stroke, in.	30½x32	30x32	30x32	27x32	30x32	27x32	30x32	29½x32	30x32	30x32	29x32	30x32	30x32	30½x32	29¾x32	27x32	29x32	31x32
Driving wheels, diameter, in.	62	61	61	57	63	57	63	63½	63	63	57	63	63	61½	64	60	63	64
Boiler Data																		
Steam pressure, lb.	250	225	225	200	190	200	195	200	190	200	200	220	210	220	220	250	255	250
Fuel	Soft coal	Soft coal	Soft coal	Soft coal	Soft coal	Soft coal	Soft coal	Oil	Soft coal	Soft coal	Soft coal	Oil	Coal	Soft coal	Soft coal	Soft coal	Oil	Soft coal
Boiler, diameter, first ring, in.	82	92	92	86	88	86	88	90	88	84	96	88	88	90	90	84½	86½	92
Firebox, length, in.	126	131⅞	131⅞	114⅛	132⅛	114⅛	132⅛	132	132⅛	120⅛	120	132⅛	132¼	144¼	132⅛	126⅛	150⅛	150⅛
Firebox, width, in.	79⅞	114	114	96¼	96¼	96¼	96¼	90	96¼	96¼	96¼	96	96¼	108⅛	96	96¼	96¼	102¼
Tubes, number and diameter, in.	120—2¼	252—2¼	252—2¼	247—2¼	271—2¼	240—2¼	256—2¼	261—2¼	271—2¼	210—2¼	264—2¼	255—2¼	260—2¼	244—2¼	232—2¼	33—2¼	82—2¼	87—2¼
Flues, number and diameter, in.	170—3¼	64—5½	64—5½	45—5½	50—5½	45—5½	50—5½	50—5½	50—5½	50—5½	60—5½	54—5½	50—5½	58—5½	53—5½	192—3½	184—3½	222—3½
Length over tube sheets, ft. and in.	19—1	17—0	17—0	20—6	20—6	20—2	20—6	21—0	20—6	23—1	21—6	20—9	20—6	22—3	23—0	22—0	21—6	21—6
Grate area, sq. ft.	69.9	104.5	104.5	76.3	83.2	76.3	88.2	82.5	88.3	80.3	80.3	88.3	88.4	108	88	84.4	100	106.5
Heating surface, firebox, total, sq. ft.	287	402	360	373	429	445	426	381	504	445	356	417	483	446	389	423	473	449
Heating surface, tubes and flues, sq. ft.	4,303	4,071	4,071	4,293	4,727	4,140	4,549	4,722	4,727	4,495	5,178	4,711	4,597	5,056	4,881	4,280	4,640	5,455
Heating surface, total evap., sq. ft.	4,590	4,473	4,431	4,666	5,156	4,585	4,975	5,103	5,233	4,940	5,534	5,128	5,080	5,502	5,270	4,703	5,113	5,904
Superheating surface, sq. ft.	1,634	1,248	1,248	1,085	1,230	1,066	1,230	1,329	1,285	1,424	1,558	1,405	1,270	1,840	1,512	2,208	2,100	2,487
Comb. evap. and super. surface, sq. ft.	6,224	5,721	5,679	5,751	6,386	5,651	6,205	6,432	6,518	6,364	7,092	6,533	6,350	7,342	6,782	6,911	7,213	8,391
Proportions and Ratios																		
Weight on drivers ÷ weight of engine, per cent.	91.3	91.2	92.3	77.8	77.1	74.2	77.3	76.9	77.0	78.4	78.5	77.5	77.6	80.3	78.8	69.0	66.8	69.1
Weight on drivers ÷ tractive force	3.92	4.04	4.30	3.95	3.96	3.99	4.00	4.07	4.18	4.08	4.01	3.75	4.02	3.89	4.12	3.81	3.58	3.93
Weight of engine ÷ comb. h. s.	62.0	69.8	73.8	61.2	59.5	64.3	63.2	61.8	61.6	63.6	57.7	63.2	66.3	59.9	64.0	60.6	62.7	61.0
Firebox surface per cent evap. h. s.	6.25	8.99	8.13	7.99	8.32	9.71	8.56	7.47	9.45	9.01	6.43	8.12	9.52	8.11	7.40	8.99	9.25	7.60
Firebox surface ÷ grate area	4.11	3.85	3.44	4.87	4.90	5.90	4.83	4.62	5.70	5.54	4.43	4.72	5.47	4.13	4.42	5.01	4.73	4.22
Superheat. surface per cent comb. h. s.	26.3	21.8	22.0	18.85	19.27	19.2	19.8	20.7	19.7	22.4	22.0	21.5	20.0	25.1	22.3	31.9	29.1	29.6
Tractive force ÷ comb. h. s.	14.46	15.73	15.83	12.07	11.58	12.30	12.19	11.70	11.33	12.23	11.32	13.05	12.83	12.33	12.41	11.1	11.7	10.7
Tractive force × dia. drivers ÷ comb. h. s.	897	960	966	687	730	701	768	742	714	771	644	822	808	758	795	666	739	686
Comb. heat. surface ÷ grate area	89.0	54.7	54.4	75.4	72.4	74.0	70.4	78.0	73.0	79.2	88.3	74.0	71.9	68.0	77.1	82.0	72.1	78.8
Notes	b-e-f-k	b-c	b-c	b-c	b-c	b-c-d-g	b-c	b-c-e-g	b-c-d	a-d-e	a-c-e-g	b-c-e-g	b-c-d-e	b-c-d-h	b-c	a-c-d-e-f-g-k	b-c-d-e-f-g-k	b-c-e-f-k

Key to notes: a—Boiler diam., inside; b—Boiler diam., outside; c—Combustion chamber; d—Syphon; e—Feedwater heater; f—Limited cut-off; g—Booster or Aux. Loco.; h—Exhaust steam injector; k—Type E superheater.

Canadian National Maintenance Regulations Effective

Their adoption has increased quality of workmanship and has reduced repair costs

AT THE time of the consolidation of the various railroads which now comprise the Canadian National Railways, one of the most important problems faced by the management was the necessity for thoughtful re-organization and re-adjustment in all departments in order to secure judicial, economical and progressive operation. The co-operation of the officers and the men, although a very essential factor and accomplishing much, could not alone achieve this result. It was necessary to establish a common understanding of operating methods that all might work together intelligently under definite instructions which would minimize the possibility of overlapping work and mistakes caused through misunderstanding and misconception of the working principles.

Formulation of the Maintenance Regulations

This was particularly true in the mechanical department. At the time of the consolidation the repair forces in the locomotive and car departments were working according to methods and regulations previously established. This made it a difficult matter to transfer equipment from one region to another, which was found to be a great inconvenience to the railway company.

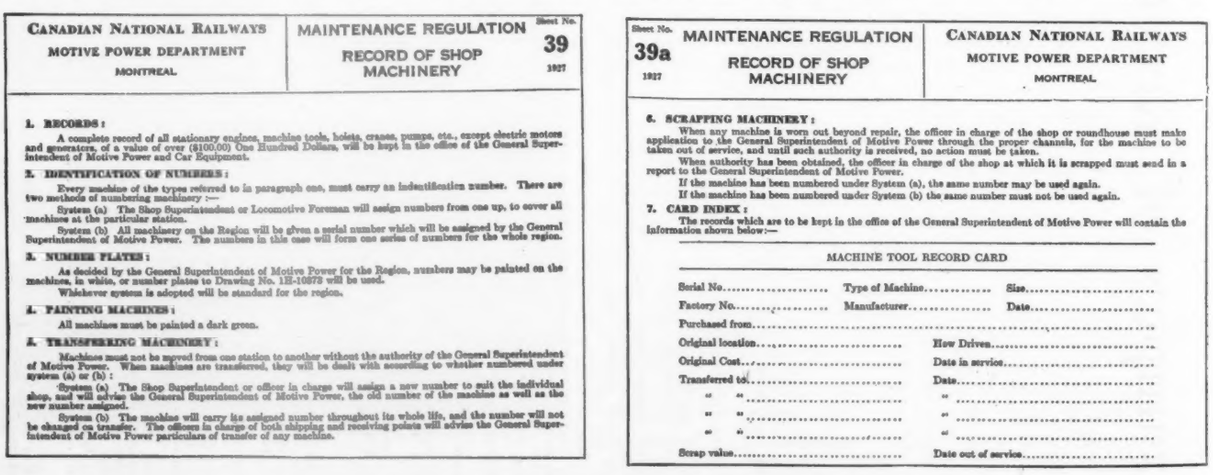
As a result of this condition it was decided to draw up a set of maintenance regulations to be strictly adhered to in all locomotive and car shops, enginehouses and repair points on the entire system. The objective held in view was that standard shop methods having been established the standardization of equipment would quickly follow, thus effecting economy in the maintenance of rolling stock.

The general maintenance work was divided first into different departments or crafts; i.e., boiler shop, erecting shop, blacksmith shop, machine shop, tender shop, power plant, etc., and shop operations considered in order of importance. Study was made of the various methods then in force on the respective railways comprising the Canadian National System, also of the methods followed on other roads in Canada and in the United States. Standard maintenance regulations were drawn up, setting forth in a clear, concise manner the methods considered to be the most modern and most efficient. The regulations were written in short paragraphs giving each operation, in the order to be followed throughout the work, as briefly and as completely as possible. Definite headings were given to each paragraph, thus making it possible for the operator to locate at a glance that portion having direct reference to the part of the work being performed, together with blueprint references and specifications of material where required.

How the Regulations Are Revised

With the completion of the initial set of maintenance regulations which were approved by the chief of motive power and issued under the instructions of the vice-president of operation, committees were formed in the locomotive, car and air brake departments to meet once each year for the purpose of considering additions and revisions to the regulations. The maintenance regulation books are in loose-leaf form so that when revisions are made it is a simple matter to replace sheets or add new ones in consecutive order.

Complete sets of regulations are issued to all members of the supervisory forces, and it is left to them individually to place the information in the shops in the



CANADIAN NATIONAL RAILWAYS
MOTIVE POWER DEPARTMENT
MONTREAL

MAINTENANCE REGULATION
RECORD OF SHOP MACHINERY

Sheet No. 39
1927

1. RECORDS:
A complete record of all stationary engines, machine tools, hoists, cranes, pumps, etc., except electric motors and generators, of a value of over ($100.00) One Hundred Dollars, will be kept in the office of the General Superintendent of Motive Power and Car Equipment.

2. IDENTIFICATION OF NUMBERS:
Every machine of the types referred to in paragraph one, must carry an identification number. There are two methods of numbering machinery:—
System (a) The Shop Superintendent or Locomotive Foreman will assign numbers from one up, to cover all machines at the particular station.
System (b) All machinery on the Region will be given a serial number which will be assigned by the General Superintendent of Motive Power. The numbers in this case will form one series of numbers for the whole region.

3. NUMBER PLATES:
As decided by the General Superintendent of Motive Power for the Region, numbers may be painted on the machines, in white, or number plates to Drawing No. 12-10873 will be used.
Whichever system is adopted will be standard for the region.

4. PAINTING MACHINES:
All machines must be painted a dark green.

5. TRANSFERRING MACHINERY:
Machines must not be moved from one station to another without the authority of the General Superintendent of Motive Power. When machines are transferred, they will be dealt with according to whether numbered under system (a) or (b):
System (a) The Shop Superintendent or officer in charge will assign a new number to suit the individual shop, and will advise the General Superintendent of Motive Power, the old number of the machine as well as the new number assigned.
System (b) The machine will carry its assigned number throughout its whole life, and the number will not be changed on transfer. The officers in charge of both shipping and receiving points will advise the General Superintendent of Motive Power particulars of transfer of any machine.

Sheet No. 39a
1927

MAINTENANCE REGULATION
RECORD OF SHOP MACHINERY

CANADIAN NATIONAL RAILWAYS
MOTIVE POWER DEPARTMENT
MONTREAL

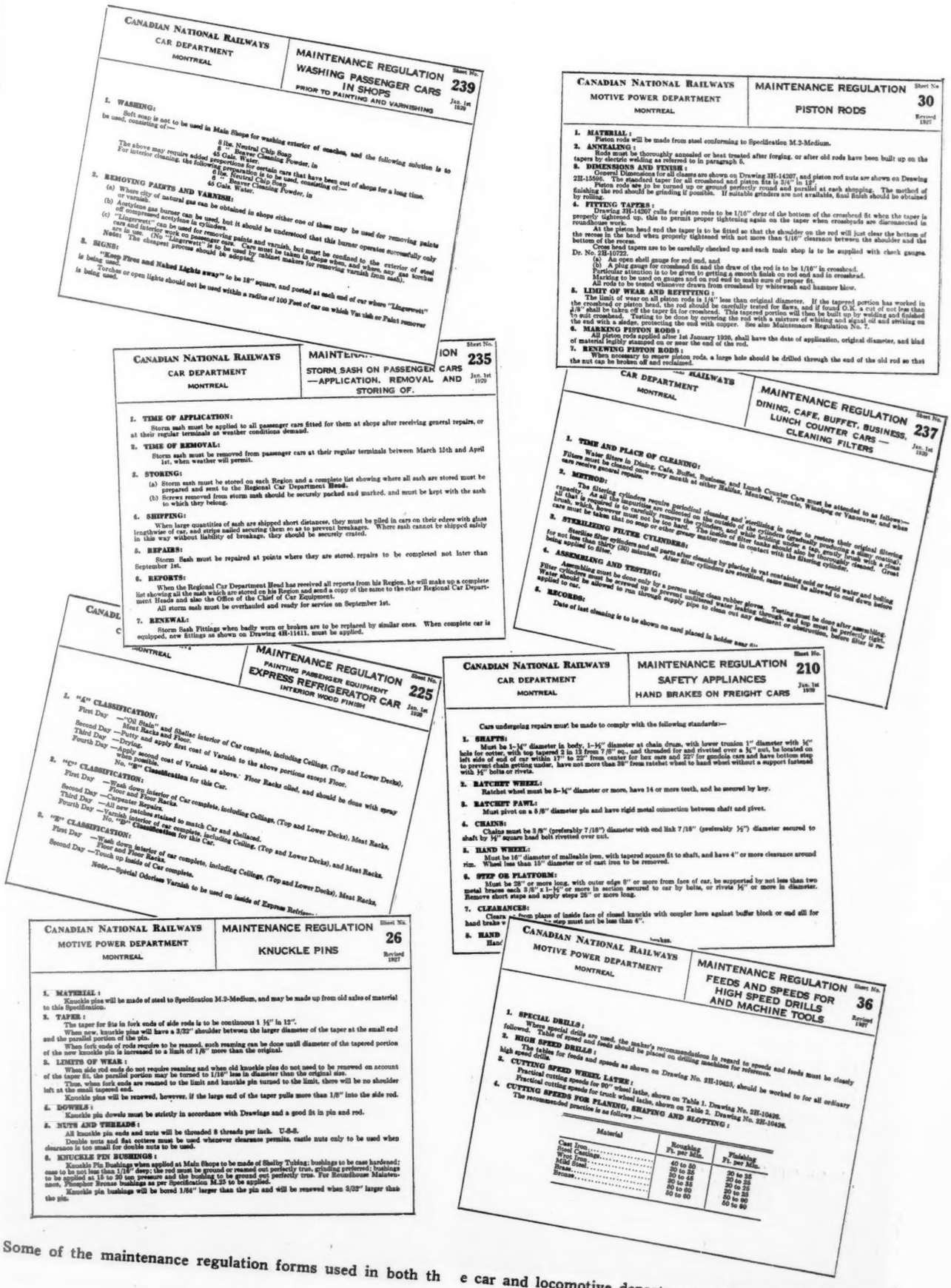
6. SCRAPPING MACHINERY:
When any machine is worn out beyond repair, the officer in charge of the shop or roundhouse must make application to the General Superintendent of Motive Power through the proper channels, for the machine to be taken out of service, and until such authority is received, no action must be taken.
When authority has been obtained, the officer in charge of the shop at which it is scrapped must send in a report to the General Superintendent of Motive Power.
If the machine has been numbered under System (a), the same number may be used again.
If the machine has been numbered under System (b) the same number must not be used again.

7. CARD INDEX:
The records which are to be kept in the office of the General Superintendent of Motive Power will contain the information shown below:—

MACHINE TOOL RECORD CARD

Serial No.....	Type of Machine.....	Size.....
Factory No.....	Manufacturer.....	Date.....
Purchased from.....		
Original location.....		How Driven.....
Original Cost.....		Date in service.....
Transferred to.....		Date.....
" "		" .....
" "		" .....
" "		" .....
Scrap value.....		Date out of service.....

The shop machinery form used on the Canadian National



CANADIAN NATIONAL RAILWAYS
CAR DEPARTMENT
MONTREAL

MAINTENANCE REGULATION
WASHING PASSENGER CARS IN SHOPS
PRIOR TO PAINTING AND VARNISHING

Sheet No. 239
Jan. 1st 1929

1. WASHING:
Soft soap is not to be used in Main Shops for washing exterior of coaches, and the following solution is to be used, consisting of:—
8 lbs. Neutral Chip Soap.
6 " Beaver Cleaning Powder, in
45 Gals. Water.
The above may require added proportions for certain cars that have been out of shops for a long time.
For interior cleaning, the following proportions is to be used, consisting of:—
6 lbs. Neutral Chip Soap.
6 " Beaver Cleaning Powder, in
45 Gals. Water.

2. REMOVING PAINTS AND VARNISH:
(a) Where city of natural gas can be obtained in shops either one of these may be used for removing paints or varnish.
(b) Acetylene gas burner can be used, but it should be understood that this burner operates successfully only of compressed acetylene in cylinders.
(c) "Lingerwett" can be used for removing paints and varnish, but must be confined to the exterior of steel cars and interior work on passenger cars. Care must be taken in shops when, and where, any gas torches are in use. (No "Lingerwett" in to be used by cabinet makers for removing varnish from mahogany.
Note: The cheapest process should be adopted.

3. SIGNS:
"Keep Fires and Naked Lights away" to be 18" square, and posted at each end of car where "Lingerwett" is being used.
Torches or open lights should not be used within a radius of 100 Feet of car on which Var nish or Paint remover is being used.

CANADIAN NATIONAL RAILWAYS
MOTIVE POWER DEPARTMENT
MONTREAL

MAINTENANCE REGULATION
PISTON RODS

Sheet No. 30
Revised 1927

1. MATERIAL:
Piston rods will be made from steel conforming to Specification M.2-Medium.
2. ANNEALING:
Rods must be thoroughly annealed or heat treated after forging, or after old rods have been built up on the tapers by electric welding as referred to in paragraph 5.
3. DIMENSIONS AND FINISH:
General Dimensions for all classes are shown on Drawing 2H-14207, and piston rod nuts are shown on Drawing 2H-15506. The standard taper for all crosshead and piston fits is 3/4" in 12".
Piston rods are to be turned up or ground perfectly round and parallel at each shopping. The method of finishing the rod should be grinding if possible. If suitable grinders are not available, final finish should be obtained by rolling.
4. FITTING TAPERS:
Drawing 2H-14207 calls for piston rods to be 1/16" clear of the bottom of the crosshead fit when the taper is properly tightened up, this to permit proper tightening again on the taper when crossheads are disconnected in roundhouse work.
At the piston head end the taper is to be fitted so that the shoulder on the rod will just clear the bottom of the recess in the head when properly tightened with not more than 1/16" clearance between the shoulder and the bottom of the recess.
Cross head tapers are to be carefully checked up and each main shop is to be supplied with check gauges. Dr. No. 2H-10722.
(a) An open shell gauge for rod end, and
(b) A plug gauge for crosshead fit and the draw of the rod is to be 1/16" in crosshead.
Particular attention is to be given to getting a smooth finish on rod end and in crosshead.
Marking to be used on gauges and on rod end to make sure of proper fit.
All rods to be tested whenever drawn from crosshead by whitewash and hammer blow.
5. LIMIT OF WEAR AND REFITTING:
The limit of wear on all piston rods is 1/4" less than original diameter. If the tapered portion has worked in the crosshead or piston head, the rod should be carefully treated for flaws, and if found O.K. a cut of not less than 1/8" shall be taken off the taper fit for crosshead. This tapered portion will then be built up by welding and finished to suit crosshead. Turning to be done by covering the rod with a mixture of whiting and signal oil and striking on the end with a sledge, protecting the end with copper. See also Maintenance Regulation No. 7.
6. MARKING PISTON RODS:
All piston rods applied after 1st January 1926, shall have the date of application, original diameter, and kind of material legibly stamped on or near the end of the rod.
7. RENEWING PISTON RODS:
When necessary to renew piston rods, a large hole should be drilled through the end of the old rod so that the nut can be broken off and reclaimed.

CANADIAN NATIONAL RAILWAYS
CAR DEPARTMENT
MONTREAL

MAINTENANCE REGULATION
STORM SASH ON PASSENGER CARS —APPLICATION, REMOVAL AND STORING OF.

Sheet No. 235
Jan. 1st 1929

1. TIME OF APPLICATION:
Storm sash must be applied to all passenger cars fitted for them at shops after receiving general repairs, or at their regular terminals as weather conditions demand.
2. TIME OF REMOVAL:
Storm sash must be removed from passenger cars at their regular terminals between March 15th and April 1st, when weather will permit.
3. STORING:
(a) Storm sash must be stored on each Region and a complete list showing where all sash are stored must be prepared and sent to the Regional Car Department Head.
(b) Screws removed from storm sash should be securely packed and marked, and must be kept with the sash to which they belong.
4. SHIPPING:
When large quantities of sash are shipped short distances, they must be piled in cars on their edges with glass lengthwise of car, and strips nailed securing them so as to prevent breakages. Where sash cannot be shipped safely in this way without liability of breakage, they should be securely crated.
5. REPAIRS:
Storm Sash must be repaired at points where they are stored, repairs to be completed not later than September 1st.
6. REPORTS:
When the Regional Car Department Head has received all reports from his Region, he will make up a complete list showing all the sash which are stored on his Region and send a copy of the same to the other Regional Car Department Heads and also the Office of the Chief of Car Equipment.
All storm sash must be overhauled and ready for service on September 1st.
7. RENEWAL:
Storm Sash Fittings when badly worn or broken are to be replaced by similar ones. When complete car is equipped, new fittings as shown on Drawing 4H-11411, must be applied.

CANADIAN NATIONAL RAILWAYS
CAR DEPARTMENT
MONTREAL

MAINTENANCE REGULATION
DINING, CAFE, BUFFET, BUSINESS, LUNCH COUNTER CARS — CLEANING FILTERS

Sheet No. 237
Jan. 1st 1929

1. TIME AND PLACE OF CLEANING:
Water filters in Dining, Cafe, Buffet, Business, and Lunch Counter Cars must be attended to as follows:—
Filters must be cleaned once every month at either Halifax, Montreal, Toronto, Winnipeg or Vancouver, and when cars receive general repairs.
2. METHOD:
The filtering cylinders require periodical cleaning and sterilizing in order to restore their original filtering capacity. As all the impurities are collected on the outside of the cylinders (gradually producing a slimy coating), all that is required is to carefully remove the cylinders, and while holding under a tap, brushing a slimy coating), brush, which, however must not be too hard. The inside of filter cylinders should also be thoroughly cleaned. Great care must be taken that no soap or other greasy matter comes in contact with the filtering cylinder.
3. STERILIZING FILTER CYLINDERS:
Sterilize filter cylinders and all parts after cleaning by placing in vat containing cold or tepid water and boiling for not less than thirty (30) minutes. After filter cylinders are sterilized, same must be allowed to cool down before being applied to filter.
4. ASSEMBLING AND TESTING:
Assembling must be done only by a person using clean rubber gloves. Testing must be done after assembling. Water should be allowed to run through supply pipes to clean out any sediment or obstruction, before filter is re-applied to car.
5. RECORDS:
Date of last cleaning is to be shown on card placed in holder near e...

CANADIAN NATIONAL RAILWAYS
MONTREAL

MAINTENANCE REGULATION
PAINTING PASSENGER EQUIPMENT
EXPRESS REFRIGERATOR CAR
INTERIOR WOOD FINISH

Sheet No. 225
Jan. 1st 1926

1. "A" CLASSIFICATION:
First Day —"Oil Stain" and Shellac interior of Car complete, including Ceilings, (Top and Lower Decks), Meat Racks and Floor.
Second Day —Putty and apply first coat of Varnish to the above portions except Floor.
Third Day —Drying.
Fourth Day —Apply second coat of Varnish as above. Floor Racks oiled, and should be done with spray when possible.
No. "B" Classification for this Car.
2. "C" CLASSIFICATION:
First Day —Wash down interior of Car complete, including Ceilings, (Top and Lower Decks), Meat Racks, Floor and Floor Racks.
Second Day —Carpenter Repairs.
Third Day —All new patches stained to match Car and shellaced.
Fourth Day —Varnish interior of car complete, including Ceilings, (Top and Lower Decks), and Meat Racks.
No. "B" Classification for this Car.
3. "B" CLASSIFICATION:
First Day —Wash down interior of car complete, including Ceilings, (Top and Lower Decks), and Meat Racks. Floor and Floor Racks.
Second Day —Touch up inside of Car complete.
Note.—Special Odorless Varnish to be used on inside of Express Refrig...

CANADIAN NATIONAL RAILWAYS
CAR DEPARTMENT
MONTREAL

MAINTENANCE REGULATION
SAFETY APPLIANCES
HAND BRAKES ON FREIGHT CARS

Sheet No. 210
Jan. 1st 1929

Cars undergoing repairs must be made to comply with the following standards:—
1. SHAFTS:
Must be 1-1/4" diameter in body, 1-1/4" diameter at chain drum, with lower trunion 1" diameter with 1/4" hole for cotter, with top tapered 2 in 12 from 7/8" sq., and threaded for and rivetted over a 1/4" nut, be located on left side of end of car within 17" to 22" from center for box cars and 22" for gondola cars and have bottom stay to prevent chain getting under, have not more than 36" from ratchet wheel to hand wheel without a support fastened with 1/2" bolts or rivets.
2. RATCHET WHEEL:
Ratchet wheel must be 8-1/4" diameter or more, have 14 or more teeth, and be secured by key.
3. RATCHET PAWL:
Must pivot on a 5/8" diameter pin and have rigid metal connection between shaft and pivot.
4. CHAINS:
Chains must be 3/8" (preferably 7/16") diameter with end link 7/16" (preferably 1/2") diameter secured to shaft by 1/2" square head bolt rivetted over nut.
5. HAND WHEEL:
Must be 16" diameter of malleable iron, with tapered square fit to shaft, and have 4" or more clearance around rim. Wheel less than 15" diameter or of cast iron to be removed.
6. STEP OR PLATFORM:
Must be 28" or more long, with outer edge 8" or more from face of car, be supported by not less than two metal braces each 3/8" x 1-1/4" or more in section secured to car by bolts, or rivets 1/2" or more in diameter. Removes short steps and apply steps 28" or more long.
7. CLEARANCE:
Clear... from plane of inside face of closed knuckle with coupler horn against buffer block or end sill for hand brake w... step must not be less than 4".
8. HAND
Han...

CANADIAN NATIONAL RAILWAYS
MOTIVE POWER DEPARTMENT
MONTREAL

MAINTENANCE REGULATION
KNUCKLE PINS

Sheet No. 26
Revised 1927

1. MATERIAL:
Knuckle pins will be made of steel to Specification M.2-Medium, and may be made up from old sales of material to this Specification.
2. TAPER:
The taper for 9/8 in fork ends of side rods is to be continuous 1 1/4" in 12".
When new, knuckle pins will have a 3/32" shoulder between the larger diameter of the taper at the small end and the parallel portion of the pin.
When fork ends of rods require to be reamed, such reaming can be done until diameter of the tapered portion of the new knuckle pin is increased to a limit of 1/8" more than the original.
3. LIMITS OF WEAR:
When side rod ends do not require reaming and when old knuckle pins do not need to be renewed on account of the taper fit, the parallel portion may be turned to 1/16" less in diameter than the original size.
Thus, when fork ends are reamed to the limit and knuckle pin turned to the limit, there will be no shoulder left at the small tapered end.
Knuckle pins will be renewed, however, if the large end of the taper pulls more than 1/8" into the side rod.
4. DOWELS:
Knuckle pin dowels must be strictly in accordance with Drawings and a good fit in pin and rod.
5. NUTS AND THREADS:
All knuckle pin ends and nuts will be threaded 8 threads per inch. U-S-S.
Double nuts and flat cotters must be used whenever clearance permits, castle nuts only to be used when clearance is too small for double nuts to be used.
6. KNUCKLE PIN BUSHINGS:
Knuckle Pin Bushings when applied at Main Shops to be made of Shelby Tubing; bushings to be case hardened; case to be not less than 1/16" deep; the rod must be ground or reamed out perfectly true, grinding preferred; bushings to be applied at 15 to 20 ton pressure and the bushing to be ground out perfectly true. For Roundhouse Maintenance, Phosphor Bronze bushings as per Specification M.25 to be applied.
Knuckle pin bushings will be bored 1/64" larger than the pin and will be renewed when 3/32" larger than the pin.

CANADIAN NATIONAL RAILWAYS
MOTIVE POWER DEPARTMENT
MONTREAL

MAINTENANCE REGULATION
FEEDS AND SPEEDS FOR HIGH SPEED DRILLS AND MACHINE TOOLS

Sheet No. 36
Revised 1927

1. SPECIAL DRILLS:
Where special drills are used, the maker's recommendations in regard to speeds and feeds must be closely followed. Table of speed and feeds should be placed on drilling machines for reference.
2. HIGH SPEED DRILLS:
The tables for feeds and speeds as shown on Drawing No. 2H-10423, should be worked to for all ordinary high speed drills.
3. CUTTING SPEED WHEEL LATHE:
Practical cutting speeds for 60" wheel lathe, shown on Table 1. Drawing No. 2H-10428.
Practical cutting speeds for truck wheel lathe, shown on Table 2. Drawing No. 2H-10428.
4. CUTTING SPEEDS FOR PLANING, SHAPING AND SLOTTING:
The recommended practice is as follows:—

Material	Roughing Ft. per Min.	Finishing Ft. per Min.
Cast Iron	40 to 60	50 to 75
Steel Castings	30 to 35	30 to 35
Wrot Iron	30 to 45	30 to 35
Mild Steel	30 to 35	30 to 35
Brass	50 to 60	50 to 75
Bronze	50 to 60	50 to 75
		50 to 60

Some of the maintenance regulation forms used in both th e car and locomotive departments of the Canadian National

form they consider the most convenient. When revised or new sheets are issued, it is the duty of the supervising officers to instruct the men thoroughly in all methods outlined in such sheets and to see that all instructions are accurately carried out.

Marked improvement has been noted in the class of work being performed since the adoption of the maintenance regulations. The standard methods employed have enabled the shops to tool and jig their machines, etc., thus effecting economy. The regulations have provided a definite and constructive basis for the various classes of work and have promoted greater confidence and clearer understanding not only among the supervising officers, but also among the rank and file, resulting in greater efficiency, conservation of time and material and the gradual standardization of the shop forces and equipment.

Results Obtained

Keen interest has been displayed by both supervisors and men in the approved standards. Knowing that suggestions as to new methods will receive thoughtful consideration, they are continually on the alert to advance or devise improvements which will assist towards perfecting the work. This attitude improves the quality of the work and is also instrumental in the development of new tools and devices, many of which have proved of great benefit. When new methods or devices for performing work are submitted to the mechanical officers, they are passed on to other shops, with any sketches or drawings which may have been made up, for test and comparison with existing methods and, if proved to be practicable, are incorporated in the maintenance regulations to be included in the next issue of the revised sheets. The study of maintenance methods has also been the means of developing ideas which had previously been in a more or less elementary state and has placed such ideas on a practical basis.

Another result of the adoption of standard methods of maintenance has been to limit the scope of individual shops or shopmen for wasteful and ill-considered experimentation which results generally in confusion and the possible loss of an original idea which might have proved of value had it been developed in an efficient manner by those best qualified to carry out such experiments.

The regulations have also proved of great assistance in connection with apprentice education and have now been adopted as the basis of shop theory. In this way the theoretical side of the training is so interwoven with the practical side that when an apprentice has completed his training he is fully conversant with the standards to which he must conform and has a feeling of confidence in knowing that the maintenance regulation book may always be relied upon as an authoritative reference.

It will be of interest to the reader to note that on the Canadian National a complete measuring stick, or what is known as the unit measuring system, has been developed for the purpose of obtaining an accurate estimate of equipment maintenance. It would have been impossible to arrive at a unit basis had no definite standards been established so that all points were performing the same work by the same method and using the same class of material, etc.

The regulations cover general maintenance work, repairing and replacing of individual parts of equipment, methods of performing various operations, etc. The following might give some idea of the subjects dealt with:

Sheet No.
1 to 6 —Inspection, repairing, maintenanee of boilers
26 —Knuckle pins
35 —Leather belting
85 —Brake shoes
86 —Power reverse gear
98 —Valve setting
110 —Heat treating spring steel
231 —Electric lighting of cars
255 —Elliptic and coil springs
259 —Lettering and numbering passenger, freight and miscellaneous equipment
421 —Repairing 8½-in. cross-compound air compressors
420 —Washing out and testing main reservoirs

Examples giving a few of the maintenance regulation sheets are shown in the accompanying illustrations.

The time, comprehensive study and careful consideration which have been expended in the compilation of the regulations are already being repaid by the encouraging results shown by the improved work. It is expected, moreover, that as the process of replacement and addition of more advanced ideas is carried on the value of these regulations will correspondingly increase.

With 22,000 miles of rail stretched over an immense area, ranging from the Atlantic to the Pacific, the Canadian National is faced with many difficulties in dealing with the problems of curvatures and grades, boiler water conditions, extremes of temperature, etc., which present an extensive study to the mechanical department. It is the concensus of opinion that the maintenance regulations are most practically and effectively helping to solve these problems.

Waste Heat for Tempering Furnace

CONSIDERABLE trouble had been experienced with broken springs at the Denver shops of the Denver & Rio Grande Western, because of the uneven tempering obtained under the old flash draw system. The recent installation of a salt vat, attached directly to the high-temperature furnace and heated by the waste gases from the latter, has eliminated the greater part of this trouble, increasing the output and insuring an even temper in every leaf in the springs. The arrange-

Salt bath vat heated by gases from a high-temperature furnace

ment of the new furnace has the added value of saving the cost of firing an extra furnace to heat the salt bath and of drawing the waste heat away from the operator at the door. It requires little attention in the morning when firing up.

A stack, placed at the outer corner of the salt vat, contains a damper which is opened in the morning, and as the fire is started, the excess heat and smoke is drawn through the heating chamber beneath the salt vat. The spring maker then starts heating, forming and hardening a spring. By the time it is ready for the salt bath, the latter has been heated to a temperature of 620 deg. F. The spring is lifted with a chain block and lowered into the bath. The spring maker watches the pyrometer and, by opening and closing the damper in the stack, keeps the solution at the proper temperature. By the time the next spring is ready to draw, the first one is ready to be removed from the salt bath.

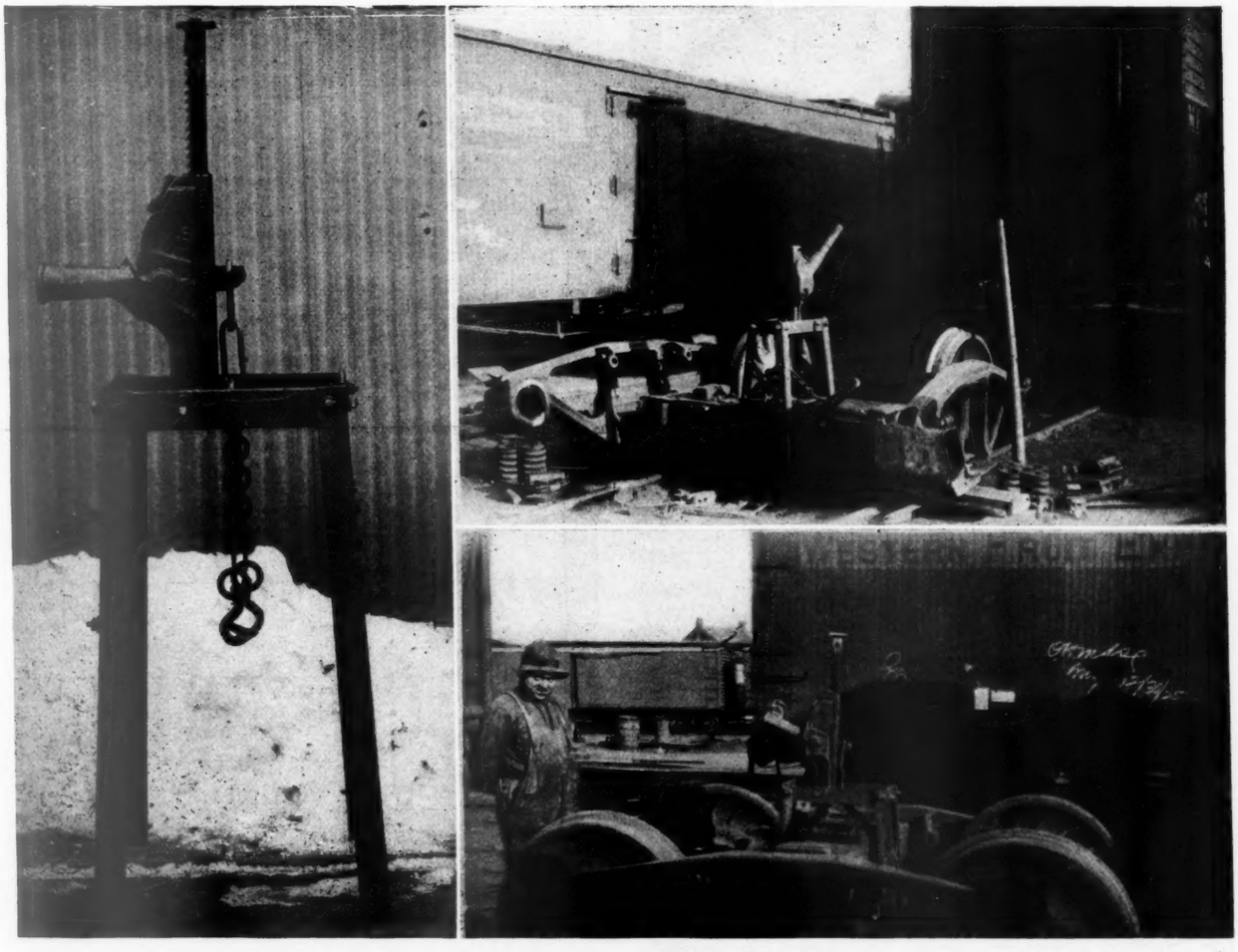
The salt vat is 2 ft. wide, 2 ft. deep and 6 ft. long, and is made from ¼-in. boiler steel. The several inches of heating space beneath and about it is enclosed with a wall of fire brick held in place with an outside sheathing made of scrap steel. Two 10-in. square openings in the dividing wall between the high-temperature furnace and that of the drawing vat allows the waste heat to be drawn through into the latter by the draft from the stack. This arrangement also tends to lengthen the life of the salt vat, as it is not exposed to the direct action of high temperatures.

A Jack Stand for Car Truck Repairs

WHEN it is necessary to renew a broken spring, a journal bearing or a pair of wheels of a car truck, it usually requires the use of one or more jacks and a heavy piece of timber in order to get the weight off of the frames so that these parts can be renewed. This practice is slow and not any too safe. A combination stand and jack has been devised at the D. L. & W. Secaucus, N. J., car repair shops whereby all parts can be renewed with one jacking.

The device consists of an angle frame on the top of which rests a ratchet-type track jack. The height and the distance between the frame legs are proportioned so that the frame will pass over the truck bolster, as illustrated, and will permit the jack to be conveniently operated. The base of the jack rests on the angles which form the top of the frame. The jack is prevented from moving by a square rod which passes through the jack base and the two sides of the frame top.

When a truck part is to be removed, the device is placed over the center of the truck bolster. A double chain is suspended from the jack lifting nose. The



Application of a combination jack and stand that simplifies truck repairs

ends of the chain are fastened to the bolster, after which the bolster is lifted off the springs and allowed to hang suspended on the chains. With the bolster in this position it is a simple operation to renew springs, journal bearings or a pair of wheels. Two pairs of wheels have been removed and replaced and the truck reassembled in 20 minutes by the use of this device.

Sturdy Pair of Carpenter Horses

THE horses used in most car shops are usually made of wood and have a tendency to break or spread under hard usage. A welder in a large repair shop constructed a pair of horses out of scrap angle

Pair of carpenter's horses that will not break or spread

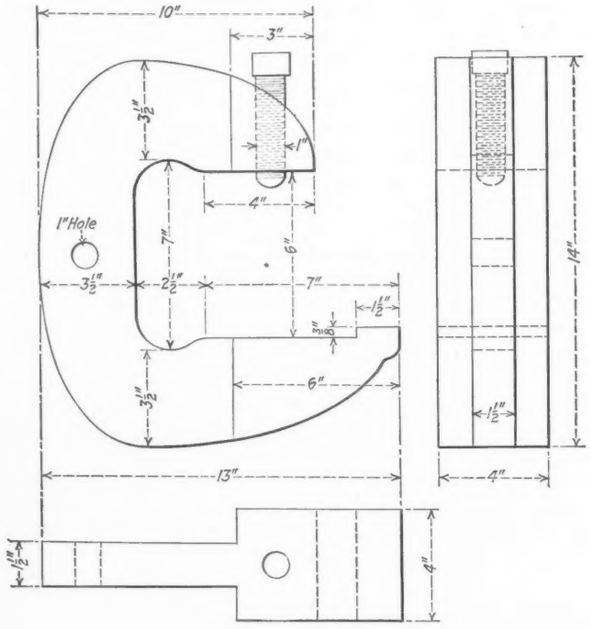
sections and bar stock. The finished product was a great improvement over the wooden ones that had formerly been used. The accompanying illustration clearly shows the construction of the horses, and the location of the welds. The pieces were all welded with butt-type joints and a small amount of welding rod was laid in the joints for extra strength.

Several Convenient Lifting Devices

By J. A. Pullar

Driving-box Foreman, St. Louis-San Francisco Springfield, Mo.

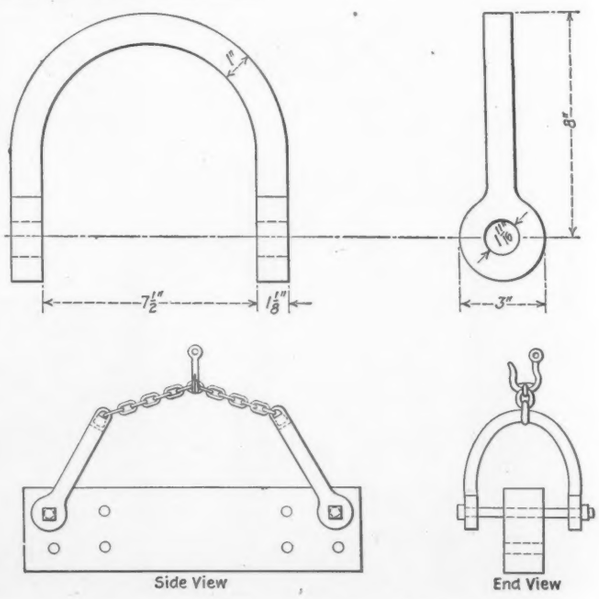
ANY device which facilitates the handling of material with maximum safety is an addition to any shop. The illustrations show several devices which fall in this category. Of particular interest is the C-clamp for handling locomotive tires. The lower jaw entends 3 in. beyond the upper jaw which is 10 in. long. The width of the opening between the jaws is 26 in. The safety feature of this clamp is that an offset lip 1½ in. long and ⅜ in. high is formed at the end of the lower jaw. This lip helps to hold the tire securely in place and to prevent it from slipping. A 1-in. set screw is



C-clamp for lifting locomotive tires

tightened against the side of the tire to help hold it in position. A 1-in. hole in the top of the clamp furnishes a means for making a lifting hitch.

The illustration also shows two different designs of devices for lifting crosshead guides and similar locomotive parts. The sketches clearly show how they are built and used. These devices have been used to advantage in lifting locomotive parts into the lye vats and also in and out of the machines.



Devices for lifting crosshead guides and other locomotive parts

Driving Wheel Springs and Equipment for Spring Repairs*

A. R. A. Mechanical Division recommendations for equipment and methods used in spring manufacture

IN the manufacture and repairs of railroad leaf-springs, it is well to reflect upon the fact that this involves—

1. A thorough understanding of the four fundamental requirements of heating and treating to obtain proper physical characteristics.

2. Combining with the above the practical shop details entering the performance of the work.

The four fundamentals involved in obtaining the correct physical characteristics of the steel are—

1. The steel must be of uniform quality, that is, of the proper physical and chemical characteristics within the closest practical manufacturing limits.

2. Proper heating at a speed not greater than that which the steel will absorb, and thorough control of the heating in all steps of manufacture and at the proper degree and sufficiently high above the critical temperature not exceeding 1500 deg. F., in order that the drop between the furnace and quenching bath will not be sufficient to have the heat at quenching lower than the upper critical temperature

The quenching tank should be located close to the furnace door for immediate transfer of the leaves from the furnace to the bath to prevent appreciable drop of temperature.

3. The use of a quenching medium of such a nature that it will have a high rate of heat convection or transfer in order to insure the setting of the steel at the proper grain structure, and this rate must be uniform regardless of its working temperature or its age.

4. Temperature of the medium used in drawing back must be uniform throughout; that is, the leaf in its entire length must be subjected to the same temperature for the same length of time.

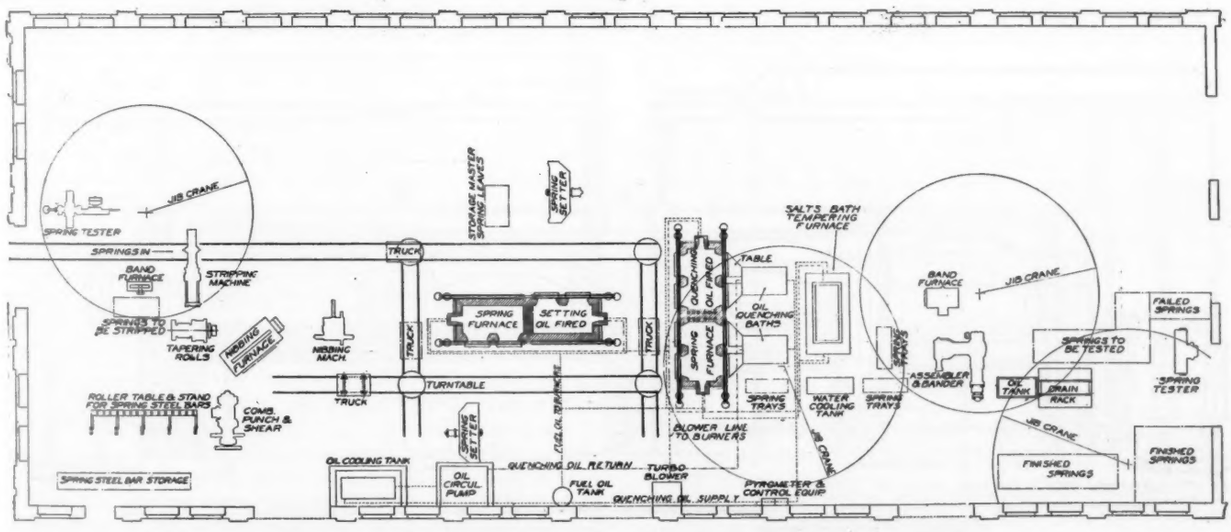
Brinnell hardness, sometimes resorted to, is not an infallible guide in determining the physical characteristics of heat treated steel.

As an illustration—Six pieces of twelve cut from the same bar were heated to 1,650 deg. F., quenched in a heavy tempering oil, left to cool and the oil then flashed off; these pieces were then checked for brinnell hardness and also for ultimate strength, elongation, etc., with the result as shown in Table No. 1.

Table No. 1

Heat "A"	Size	Area	Tensile Strength	Elongation % in 2 in.	in 4 in.	Spec. Broke, pcs.	Red. in area	Brinnell Hard.
1	¼x2	427	209,000	4.5	4.5	3	08	418
2	¼x2	430	190,000	4.0	3.5	2	06	402
3	¼x2	430	206,000	5.0	4.4	3	07	418
4	¼x2	427	202,000	6.5	5.0	3	06	402

* The report of a subcommittee of the Committee on Locomotive Design and Construction presented at the 1929 convention of the Mechanical Division, A. R. A., at Los Angeles, June 25-28, 1929. The subcommittee report was signed by George H. Emerson (chairman), chief motive power and equipment, Baltimore & Ohio; C. E. Brooks, chief motive power, Canadian National; H. A. Hoke, assistant mechanical engineer, Pennsylvania; and A. H. Fetters, general mechanical engineer, Union Pacific. This report supplements the one presented in 1928 which appeared in the July, 1928, issue of the *Railway Mechanical Engineer*.



A well laid out and equipped spring plant is of the first importance

Four of the remaining pieces were heated to 1,550 deg. F., quenched in animal hydrocarbon oil, left to cool and then subjected to 850 deg. F. in a draw back salts bath. These pieces were then checked the same as in the first condition with the result as shown in Table No. 2.

Table No. 2

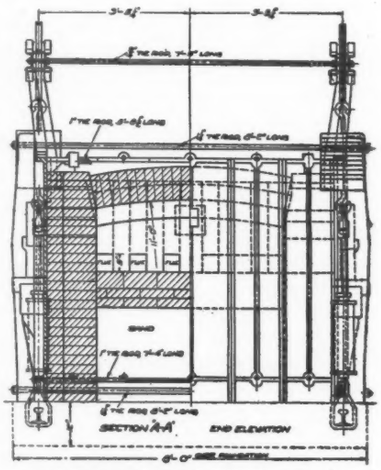
Heat "B"	Size	Area	Tensile Strength	Elongation % in 2 in.	in 4 in.	Spec. Broke, pcs.	Red. in area	Brinnell Hard.
2	¼x2	427	214,000	10.0	8.0	2	16	418
3	¼x2	427	222,000	10.0	7.5	2	09	402
4	¼x2	427	215,000	9.5	7.5	2	13	418
5	¼x2	430	221,000	12.0	9.0	2	13	418

By observing the figures given in the above two tables, it will be noted brinnell hardness is practically identical in both tests, but that in Table No. 1 the average tensile is appreciably lower than in Table No. 2, although the elongation in Table No. 2 averages more than 80 per cent higher than the elongation given in Table No. 1.

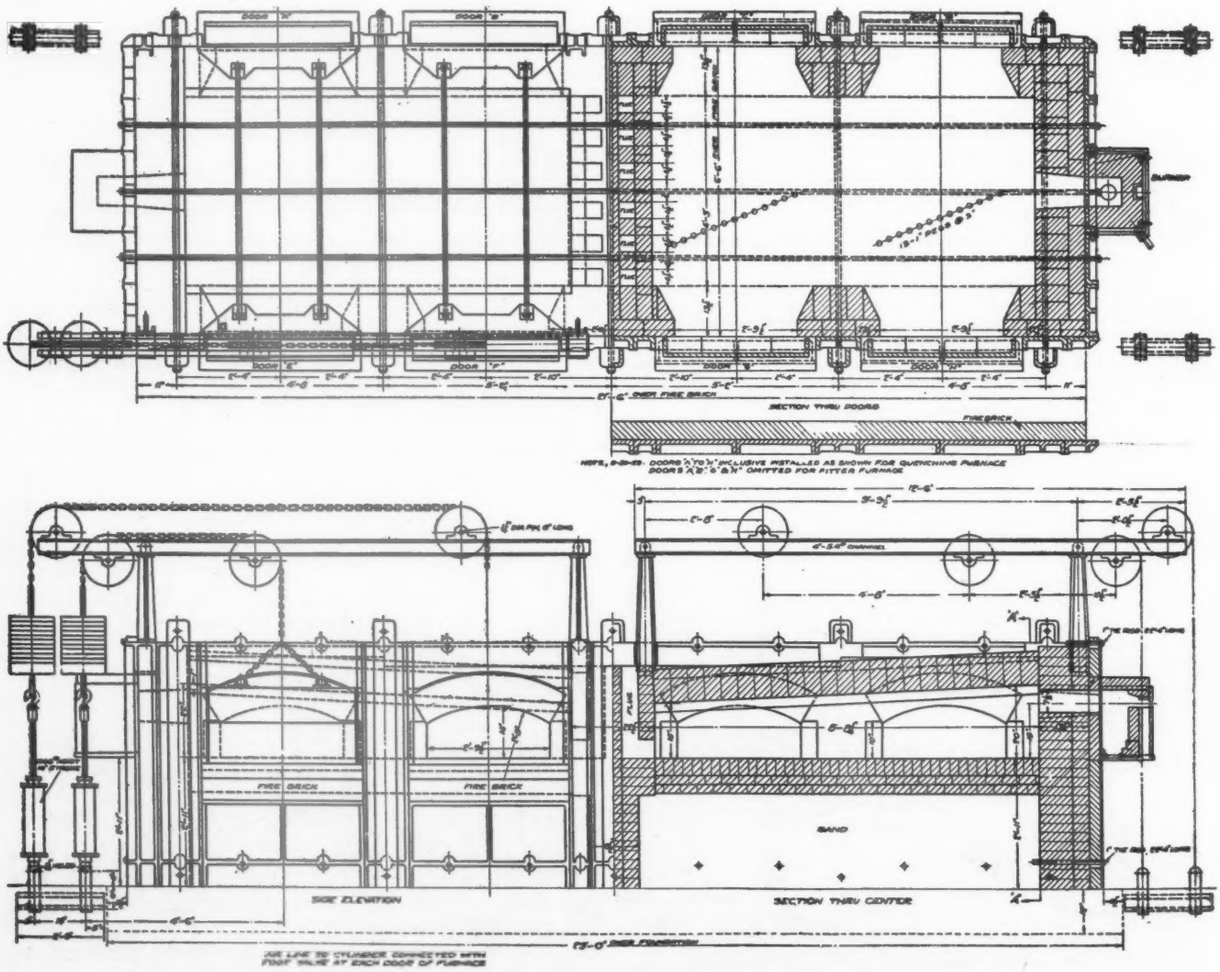
In properly heat treated pieces of steel the elongation and tensile strength have a definite relation, that is, tensile strength is the highest when elongation is the lowest and the purpose of the draw back is to introduce the necessary ductility or elongation which is done at the expense of the tensile strength. Again, observing the figures of the two tables given above, it will be found in Table No. 2 the tensile strength is high and the elongation high, whereas in Table No. 1 the tensile strength is lower and the elongation lower, whereas it should be higher as compared with the tensile strength of the test piece.

The essential feature in the springs standing up is to obtain the highest possible tensile strength with an elongation high enough to insure maximum deflection without breaking.

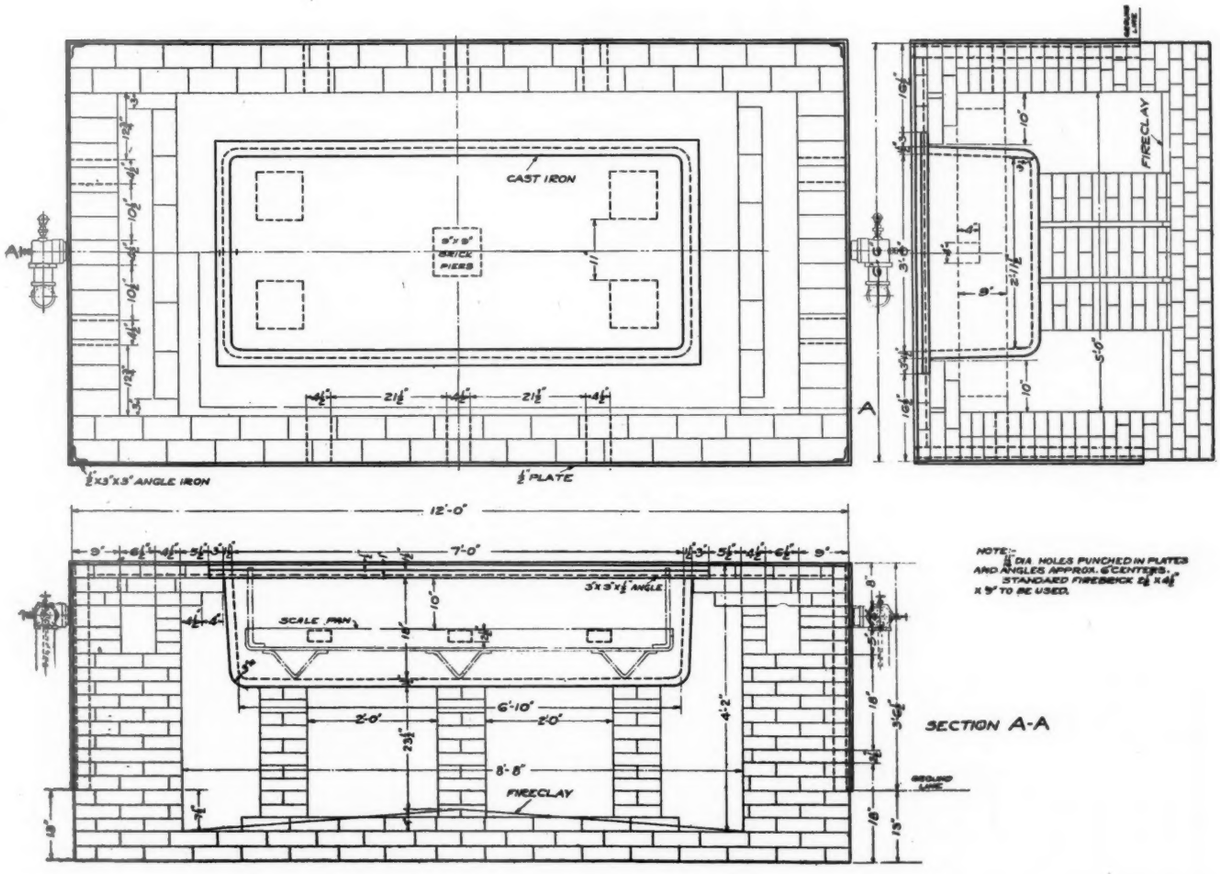
In supporting the above principles we will proceed on the basis of using carbon steel and begin with the operation from the time the broken spring reaches the spring plant. In general the specifications for carbon steel springs call for variations in carbon content from 0.90 to 1.10; it is possible to decrease this variation somewhat without increasing the cost of manufacturing the steel, as carbon content from 0.90 to 1.05 is available to be used, which will give a more uni-



End elevation of forming and quenching furnace



A satisfactory design of heating furnace for forming and quenching springs



Design of salts bath tempering furnace for drawing back

form product and reliable performance while in service.

In stripping the springs for repairs much damage to nibs as well as the leaf itself can be eliminated by heating the band before removal or cutting off cold; it has been found that many spring failures result from minor surface defects, hammer dents, scored surfaces, abraded and cracked nibs, etc., and special care should be taken to make a close inspection of the surface of the leaves and throw out such as contain any defects, no matter how slight.

New leaves are prepared in size to replace broken ones, then both new and old leaves are put in forming furnace and brought to forging temperature, shaped on forming machine and then left to cool. The leaves must be heated to not over 1,700 deg. F., nor permitted to drop below 1,450 deg. F. while being worked as overheating is likely to burn the steel or produce a grain growth and working at low temperature produces excessive internal strains. Permitting the leaves to cool is essential in normalizing strains in the new leaves and brings back the old leaves to original condition. Leaves should be left to cool to at least 450 deg. before being reheated for quenching.

After forming, the leaves should be heated in the furnace to slightly above the upper critical temperature of the steel or to 1,500 deg. F. Care and time must be taken to permit the leaves to heat thoroughly which, in the case of a spring ½ in. thick, requires about 30 min. When the leaves have attained this temperature they should be immersed immediately in the proper quenching oil and left in this oil until they will not flash the oil when removed, or about 300 deg. F. After leaves are removed from the quenching tank they should be collected in sets for the drawing operation. The leaves from which the oil has been thoroughly drained are then immersed in a salt bath which is heated to draw back temperature of 800 deg. F. for not less than 20 min. As soon as the leaves are removed from the salt they should be given a quick dip in running water which will bring them out clean. The plates are then assembled into sets for banding and after banding are dipped in a bath of oil which acts as rust preventive and lubricates the leaves.

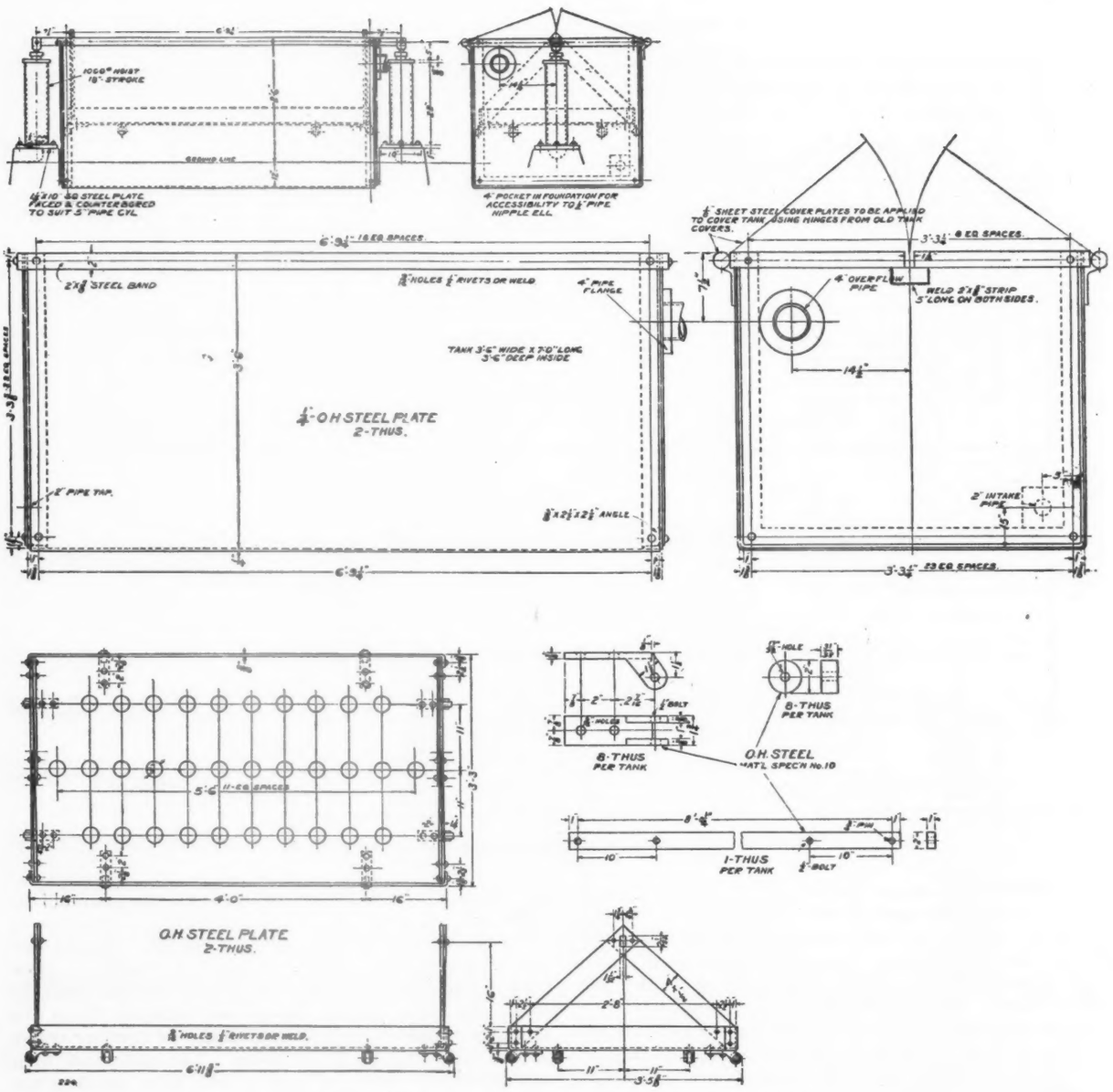
Heating Furnace for Forming and Quenching

It has been found that the furnace fired under the arch and vented off the hearth and through the side walls gives good efficiency in oil consumption and a reasonably uniform heat.

The semi-muffled furnaces are more desirable in that they eliminate the flame contact with the steel and prevent surface decarburization or soft spots.

The furnace must be of ample size to accommodate the work done. For instance, if it is desired to heat 600 lb. of springs per hour, the furnace should have an approximate size of 100 in. by 40 in. by 18 in.; these relative proportions are desirable. The furnace should be equipped with indicating and recording pyrometers—with two or more couples and so placed to give proper record of the temperatures in the furnace—and the burners should be operated by automatic control to insure close temperature operation.

Record sheets (see illustration Fig. 14) from recording pyrometers show in the upper chart the close tem-



Oil quenching tank equipped with tray elevating device

perature to which the furnace is held by automatic burner control as compared by lower chart showing the large variation of temperature through careful hand control. Heat control is necessary to prevent the leaves from being withdrawn from the furnace at the improper temperature. The leaves should be held at the quenching temperature for at least 30 minutes to insure thorough heat saturation. The furnace is in best working condition when the issuance of flame is present at the door openings. This prevents infiltration of air and gives uniform heating pressure within the entire heating chamber of the furnace; infiltration of air results in lowering the furnace temperature, the formation of cold pockets and excessive oxidation or scalding of the spring leaves. Leaves should be placed in the furnace on their edge and should be spaced not less than 2 in. apart to permit proper heating. In heating leaves, racks should be used.

Low pressure air and high pressure oil should be used for all burners. Air from 1 to 2 lb. per sq. in. and oil 5 to 15 lb. per sq. in. Low pressure air results in a soft rolling flame, whereas high pressure air gives a localized impinging flame, destructive to refractories and practically impossible to produce a uniform heat within the entire furnace.

Fuel oil should be preheated and screened ahead of burner to insure constant supply.

Quenching System

The capacity must depend upon the amount of work to be done. In general, if it is desired to quench 1000 lb. of steel per hour at any one time, the system should contain not less than 1000 gal. of the proper oil (animal hydrocarbon) and this should be circulated through a cooling system at least once an hour.

The size of the quenching tank should preferrably be sufficient to hold 900 gal. and the other 100 gal. for the circulating system. A pump is essential to sustain circulation.

Cooling equipments of high efficiency are found on

the market. In general the practice is to have the oil flow through a nest of tubes and have the water circulated around them. The tubes must be of small diameter so as to obtain the maximum amount of surface radiation. Copper tubes are preferred on account of their high heat conductivity. It is desirable to have the pressure of the oil slightly higher than pressure of the water so that in the event of leakage, the oil will leak into the water rather than the water into the oil.

Furnace for Drawing Back

The drawing operation is best accomplished in the salt bath which is a mixture of salt compounds of high heat conductivity which do not sludge, but melt at sufficiently low temperatures to permit minimum loss in draining the spring leaves.

The salt bath furnace must be properly constructed so that the flame does not impinge directly on the pot and further the heating of the pot should not be forced, that is, the salt bath should not be brought up too quickly. The capacity of the pot should be in relation of 10 lb. of drawing compound to 1 lb. of steel. The exact dimension must take into consideration the length of spring leaves to be drawn.

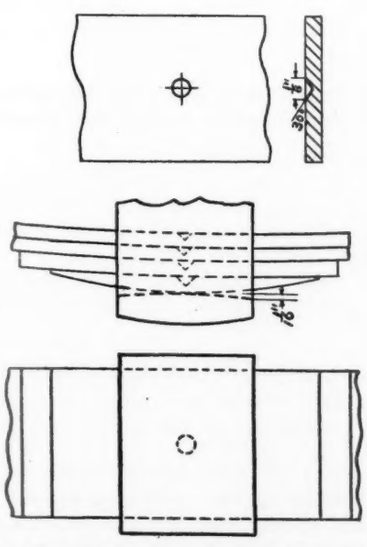
The above requirements are fulfilled by furnace illustrated. The pot should be made of cast iron; care should be taken to insure it being free of blow holes and should be equipped with a tray at the bottom to catch any scale which may be thrown from the leaves. This scale should not be allowed to accumulate but removed frequently. The leaves should be placed between adjusting spacers in trays before being immersed into the drawing solution, to permit salt bath to circulate between them.

The draw-back furnace should be equipped with pyrometer regulation and automatic time clock siren alarm to warn the operator when the salt has reached the proper temperature and also to call attention of the operator through a timing device when the leaves have been immersed 20 min.

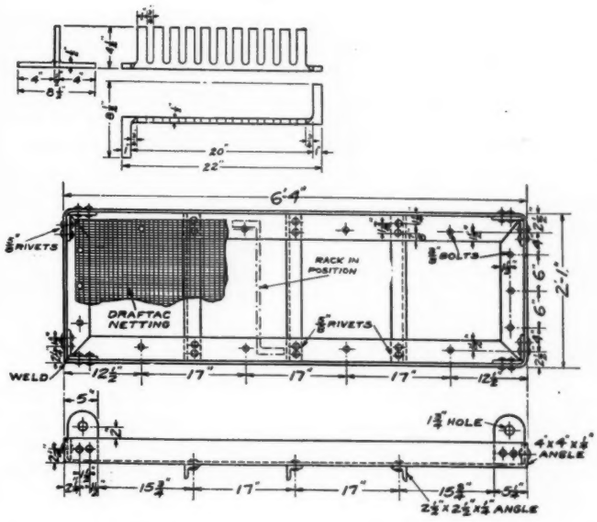
Process

(a) The steel may be made by the open hearth, crucible, or electric process.

(b) All forming should be done at the lowest temperature (not lower than 1400 deg. F.) at which the steel will work satisfactory and should in no case exceed 1700 deg. F.



Bands should have relieved bearing against the short plate



Spring leaf portage and immersing pan

(c) After forming and fitting, the leaves should be allowed to cool in air to a black heat or lower, and then reheated uniformly to a temperature of 1500 deg. F., plus or minus 25 deg. They should be held at this temperature for 30 min. and quenched instantly in the circulating oil bath, the temperature of which is kept about 150 deg., which insures maximum fluidity and minimum evaporation. The leaves should not be removed from the quenching bath while hot enough to flash the oil on the surface or about 300 deg. F.

(d) The quenched leaves shall then be drawn-back by heating to 800 deg F., plus or minimum 10 deg. F. Leaves should be placed in salt bath for 20 min. at this temperature, withdrawn and allowed to cool in air after plunging momentarily in water to remove the chemicals.

(e) In heating for quenching or drawing all the leaves for each spring must be heated at the same time and placed on edge in the furnace or salt bath so that they will not touch one another.

(f) Material at all steps of the operation while hot should not be exposed to rain, snow or cold draughts. Pyrometers should be checked at frequent intervals to insure steel being heated to proper temperatures at all times.

(g) The complete spring should be thoroughly coated by immersing in oil bath for lubrication and prevention of corrosion.

Bands

Bands of springs should be made of wrought iron and applied in the hydraulic press; it is advantageous to relieve the bearing of the band against the short plate as indicated in the illustration.

Conclusion

The above is a rather close description of the proper method for heat-treated springs, which is found to be essential. Carelessness, lack of appreciation or attention to any of the details will destroy the efficiency of the operation, as its success depends upon close attention to details. However, there is nothing difficult involved in carrying out the above description and process, and while there may be a slight modification or elabora-

tion in equipment, the system as a whole can be relied upon to give dependable results.

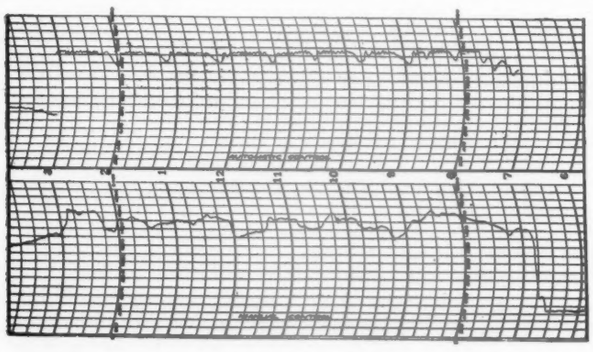
Supporting data for the above conclusions are based upon the following tests and investigations:

Fatigue Tests on Semi-Elliptic Carbon Springs

Object of Tests—The object of these tests was to determine the proper quenching and drawing temperature for standard carbon spring steel.

Material—The material used in the test springs was new carbon steel, ½ in. by 5 in. section, free from rust.

Procedure of Manufacture—Fourteen 36 in. by 15 in. springs were formed in accordance with usual practice and each spring accompanied by a test piece. These springs were heated in the quenching furnace in pairs with their corresponding test pieces to the desired temperature, then quenched in a circulating bath of animal-hydro-carbon oil. Brinnell readings were then taken on



Pyrometer record charts showing advantage of automatic control

each of the hardened test specimens. After quenching the springs were drawn in a salt bath with one test specimen representing each heat. The springs were then banded and stamped, dipped in lubricating oil and pumped down once under the tester to take up any space between the leaves.

Procedure of Test—The 14 test springs were first checked to blueprint specifications, after which the height of each was determined under a 50,000 lb. static load. Each spring was then compressed in a bulldozer 1000 times with the stroke adjusted to produce a height equivalent to that obtained under the 50,000 lb. static load. This load, applied at the rate of 500 loadings per hour by the bulldozer, was arbitrarily chosen and is double the normal working load of this type spring.

At the completion of 1000 loadings on the bulldozer the springs were again checked under the static machine and the new height under a 50,000 lb. load determined. All the springs were again returned to the bulldozer and 1000 load applications made at this new height.

Upon the completion of this second series of 1000 load applications the static load was increased to 60,000 lb. and the corresponding height used for service tests on the bulldozer. A record was nevertheless taken of the height of each spring under the 50,000 lb. load.

The fracture of any plate, except the short plate, was recorded as a failure of the spring. The number of applications and location of each break were noted.

The tests were continued in this manner, checking the heights of each spring on the static machine after each 1000 applications on the bulldozer, until 10,000 applications had been reached, when the tests were discontinued. The same jigs, slips and pins were used throughout the tests and all errors due to wear were cumulative and applicable to each spring.

Note:—A load of 40,000 lb. was applied to each spring and released each time before running them down on the static machine.

Observations—The following points were maintained constant in manufacture:—Forming temperature, 1600 deg. to 1700 deg. F. Soaking period at quenching heat, 30 min. Drawn in salt bath, 20 min. Brinnell readings taken at three points on each test specimen.

Summary of Data

Test numbers	1	2	3	4	5	6	7
Quenching heat, deg. F.	1750	1700	1650	1600	1550	1500	1450
Time to bring charge up to heat, min.	20	20	21	15	20	15	21
Temp. cold oil, deg. F.	155	115	118	125	150	148	130
Temp. hot oil, deg. F.	295	266	274	260	292	280	254
Time req. to pull heat, min.	5	5	4	5	5	3½	4½
Brinnell, hardened	418	444	477	455	444	387	387
Brinnell hardened and drawn	387	387	422	422	402	364	364
Salt bath, temp. in	835	820	835	820	840	820	825
Salt bath, temp. out	810	815	810	810	820	810	815

Complete Analysis of Steel

Carbon	1.08	Silicon	.15
Sulphur	.030	Vanadium	Nil
Phosphorus	.022	Chrome	.12
Manganese	.41	Nickel	Nil

Analysis of Carbon in Each Spring

1450-1	1.08	1600-1A	1.04
1450-1A	1.03	1650-1	1.05
1500-1	1.03	1650-1A	1.04
1500-1A	1.04	1700-1	1.04
1550-1	1.04	1700-1A	1.04
1550-1A	1.03	1750-1	1.04
1600-1	1.06	1750-1A	1.05

[Full tables and graphs, not reproduced, accompanied the report— Editor.]

Conclusions—Micro photographs, show quite plainly a grouping of the crystals at temperatures above 1650 deg. F. On the basis that the finest grain structure is a prerequisite to the properly heat treated spring, the lower quenching temperatures show a more homogeneous arrangement.

This grain structure was apparent in the specimens that were broken by bending, after being drawn back. The finer the texture the more evident the tearing action between the grains, leaving a ragged break. Specimens quenched above 1600 deg. F. show a straight, clear break with a well defined grain.

Examination of the number of deflections applied to the seven sets of springs showed that the lower temperatures respond in practice to the theory of grain structure and withstand 10,000 loadings without failure, while the springs quenched at 1750 deg. F., both broke in several places at 950 and 1275 loadings.

The results check closely with the generally accepted practice which is to quench carbon steel springs at temperatures from 1450 to 1500 deg. F.

Recommended Practice for the Manufacture of New, and Repairs to Elliptic Springs

1. Suitable layout of spring plant.

2. Spring leaves are to be heated in an automatic pyrometer controlled forming furnace at 1700 deg. F., which should not be exceeded; leaves should not be worked at heat under 1400 deg. F.

3. Heated leaves shaped to contour on forming machine, then placed on truck and allowed to cool until black to relieve internal strains.

4. Place entire spring—both new and old leaves—in an automatic pyrometer controlled quenching furnace, bring up the heat slowly to a uniform temperature of 1500 deg. F. consuming for the average spring about 30 min. time and hold at 1500 deg. F. for at least 30 min., consuming 55 to 60 min. for the entire heat. It is important that the leaves of the spring do not touch each other and should have a space of about 2 in. between each leaf to permit heat to circulate freely between leaves, leaves standing on their edge in the fur-

nace between rack pegs in the hearth of the furnace.

It is most essential that the heating of the leaves be at such a rate that heat will be thoroughly and uniformly absorbed and that they remain in the furnace a sufficient length of time to insure thorough saturation. It is very important that the heating be such that decarbonization of the surface of the leaves will not occur, since this softens the surface of the leaves in spots and varying depths, causing un-uniform strength throughout the leaves and consequently results in irregular tempering strength.

5. Remove spring leaves—after being properly heated—from the quenching furnace as speedily as possible to the quenching tank which should be located close to the furnace door and submerge instantly in quick quenching oil circulating bath which is essentially necessary in the system to set the grain of steel while at the critical temperature. The leaves should remain in the bath until cool enough to prevent flashing of the oil when they are held on the surface of the bath.

Oil quenching system capacity must be proportioned upon the amount of work to be done. To quench 1,000 lb. of steel per hour, not less than 1,000 gal. of the proper oil must be circulated by means of a pump through a cooling system at least once an hour. Oil in bath must not exceed 150 deg. F.

Capacity of the quenching tank should be not less than 900 gal. for the above, also 100 gal. in the circulating system and cooling tank. In general, the cooling tank consists of a nest of tubes through which the oil is circulated, with water surrounding the tubes.

The oil pressure should be slightly higher than the water that in the event of leakage the oil would not enter the water—water in the quenching system is detrimental.

6. Leaves making up the entire spring when removed from the oil bath should be placed in a perforated pan having seperators to prevent them touching one another. Pan and springs to be immersed in the salts bath for tempering; the salt bath furnace to be equipped with siren alarm clock, pyrometer controlled to 810 deg. F., remaining therein for 20 min. At siren alarm signal, remove the springs from the salt bath and plunge momentarily in water vat to clean off the chemicals, then remove and allow to cool in the air.

7. Material at all steps of the operation while hot should not be exposed to rain, snow dampness, or cold draught. Pyrometers should be checked at frequent intervals to insure steel being heated to proper temperature at all times.

8. Springs on all locomotives shopped for classified repairs to be removed and sent to spring plant for inspection and testing.

(a) Tested for free height; those standing up to be cleaned, lubricated and returned to service.

(b) Hammer tested for broken leaves; defective springs to have the band removed, new leaves made and entire spring (both old and new leaves) heated in tempering furnace and drawn.

(c) Springs found low in height to have bands removed, leaves reset and entire spring reheated in tempering furnace and drawn.

9. Springs, after cooling, should be placed in banding machine, banded and then removed, immersed in oil for lubrication and prevention of corrosion. Se Figs. 10 and 11.

10. All springs after completion and lubrication to be subjected to shop test of three or more deflections with a 100 per cent overload.

All springs manufactured—new or repaired— to be marked with date, size of spring and stock number stamped on band with steel stencils.

In regard to instruction, for considering specifications for spring bar stock, would say that as uniformity of the physical structure of the steel in the springs is essential to produce a regular product, a close range of carbon content is desirable; therefore, since spring leaves entering in the investigation have been easily obtained in the market where the range of carbon content was from 0.90 to 1.05, the committee recommends this limit.

The committee, therefore, recommends that there be submitted to letter ballot:

1. The recommended practice for the manufacture of new and repairs to elliptic springs.

2. That the carbon content be reduced from the present range of 0.90—1.10 to 0.90—1.05 and that it be submitted to the Committee on Specifications for their consideration, with a view of changing the table in specifications as shown in Section "A," specifications for steel bar carbon for railroad springs.

Storing Molds in the Tin Shop

THE forming molds for a bending brake used in the tin shop usually have to be kept on the floor beneath the machine, as no rack is provided with the machine. The rack attached to the rear of the machine, shown in the illustration, not only keeps the molds off the floor, but also prevents them from being damaged by heavy material falling on them. The rack is made by bolting horizontal pieces, curved upward at the outer ends, near the tops of the rear legs of machine and supporting them with braces of ¼-in. by 1-in. metal strips bolted to the lower end of the machine legs. The horizontal pieces are supported by welding them to the upper ends of the braces.

Convenient method of storing bending-brake molds

Refrigerated Transport Discussed at Penn State

Refrigerating engineers meet with Railroad Division, A.S.M.E.—Six papers presented

THE Railroad Division of the American Society of Mechanical Engineers held a joint symposium on Friday, June 21, on the subject of Handling Perishables by Rail, with the American Society of Refrigerating Engineers. This joint session was held in connection with the sixteenth annual spring meeting of the A. S. R. E., which was held at the Pennsylvania State College, State College, Pa., June 20-22, 1929, inclusive. From 60 to 80 mechanical and refrigerating engineers were present at both the morning and afternoon sessions which composed the symposium. Considering the fact that many railroad mechanical department officers were on their way to Los Angeles, Cal., to attend the annual convention of the Mechanical Division, American Railway Association, the meeting was well attended by railroad and railroad supply company representatives, who took an active part in the discussion of the six papers presented.

The morning session was devoted entirely to the economical phases pertaining to the subject. Three papers were presented at this session on the following subjects: Economic Factors in Handling Perishables by Rail, by J. W. Roberts, assistant vice-president, Pennsylvania, New York; Current Practice of Transit Refrigeration, by E. F. McPike, manager, perishable freight service, Illinois Central, Chicago, and Governing Factors in Transportation of Perishable Commodities, by L. A. Hawkins, principal physiologist, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C. The afternoon session of the symposium was devoted to the consideration of the general subject "Design of Railway Refrigeration Equipment." Three papers were also presented at this session, namely, Practice in Refrigerator Car Design, by E. A. Sweeley, mechanical superintendent, Fruit Growers Express Company, Alexandria, Va.; Research Studies of Refrigerated Trains by R. W. Waterfill, research engineer, Carrier Engineering Corporation, Newark, N. J., and Recent Applications of Refrigeration for Pre-cooling, by C. P. Goree, Jr., district engineer, Frick Company, Atlanta, Ga., and L. R. Graves, chief engineer, Edwards Ice Machine & Supply Company, Seattle, Wash.

A. W. Oakley, assistant manager technical department, Merchants Refrigerating Company, New York, presided at the morning session. The opening address was made by R. L. Sackett, dean of engineering, Pennsylvania State College. Dean Sackett spoke briefly on the increasing importance of the work of the refrigerating engineer to transportation. He stressed the need for further development in refrigeration to meet the rapidly increasing demands on the railroads for the efficient handling of perishable products from the grower to the consumer. In this he referred to the research and experimental work in heat transmission that was being done at the Penn State Engineering Experiment Station under the direction of A. J. Wood, head of the station, and president this year of the American Society of Refrigerating Engineers.

Current Practice of Transit Refrigeration

The second paper entitled "Current Practice of Transit Refrigeration," which was presented by the A.S.R.E., was prepared by Mr. McPike, and presented in abstract by David L. Fiske, secretary of the American Society of Refrigerating Engineers. Following is a brief abstract of Mr. McPike's paper:

Some idea of the size and importance of the problem of transporting perishable food products in America is afforded by the fact that, as of January 20, 1929, there were 181,171 refrigerator cars owned and operated in the United States, Canada and Mexico by railroads and private car lines.

During the calendar year 1927, 1,572,734 carloads of perishable food products were transported in the United States. These figures include fresh vegetables, fruits, meats, packing house products, butter, eggs, cheese and dressed poultry, but exclude bananas, dried apples, dried beans, canned goods, beverages, and various other commodities requiring or using refrigerator car protection. Probably about half of these total shipments move under refrigeration. This may mean an average of less than five trips per car per year under ice protection.

Economics of Increased Car Weight

There seem to be no recent records available as to the total mileage made by refrigerator cars in the United States, but some figures compiled by the Interstate Commerce Commission for the five years 1913-1917 indicate a grand average of about 2,237,942,563 miles per year, loaded and empty. This figure is subject to more or less revision in the light of present day conditions, but when used as a provisional basis it leads to some surprising results. It will serve at least to show the consequences in the way of increased operating expenses to the railroads for any additional tare weight of refrigerator cars, resulting either from increased insulation, changes of construction, or installation of special appliances. We can thus ascertain the economical limits within which refrigerator cars may reasonably be subjected by any radical changes involving added weight.

The modern steel underframe freight refrigerator car weighs about 56,000 lb., or 28 net tons. Therefore, an increase of even one ton in the tare weight, if computed at the low operating cost of three mills per gross ton mile, would amount to an additional expense of about $3,000 per million ton-miles. If these figures were then applied

so the grand total average of more than 2,237,000,000 refrigerator car-miles and treated as being also ton-miles, it would amount to a grand total gross operating expense of $6,711,000 over the cost of handling in the present style of equipment. Statistics are never enjoyable, but sometimes serve the useful purpose of showing the results or consequences of any particular plan or procedure.

It is obviously impossible to make a cold storage house out of a refrigerator car in transit, nor is there any occasion for trying to do it. The present practice of insulating refrigerator cars is giving satisfactory results in the way of adequate protective service. It is true that the railroads are still subjected to heavy payments of claims for alleged loss or damage to fresh vegetables, fruits and other perishables, but a careful analysis shows very clearly that only a small part of these claims could by any possibility have been prevented by increased insulation of the cars, or by any process of augmented refrigeration. Therefore, the added expense of applying greater insulation and the increased cost of operating the heavier weight of car would not at all be offset by any corresponding reduction of claim payments. In other words, the net increase in the cost to the railroads would have to be treated as added expense of operation, for which the carriers would be entitled to additional revenue from some source.

In order that these facts, as to their validity and relevancy, may be entirely clear, let us consider the figures covering the total claim payments by all the Class I railroads in the country on perishable freight chargeable to alleged failures of protective service, such as refrigeration, icing, ventilation, artificial heat, or freezing. All these causes, taken together, during the year 1928 resulted in claims amounting to a grand total of $1,216,186, as compared with a total of $1,433,129 in 1927, or a decrease of $216,943, which means a decrease of 15.1 per cent, notwithstanding the very hazardous character of such services.

Cost of Cars

At the present time the initial cost of building a modern freight refrigerator car is about $3,200 and an express refrigerator car would cost close to $5,000. Taking the old and new cars together, the average cost of repairs, plus a conservative allowance for annual depreciation, would amount to about $3.25 per car per year for freight refrigerators and something more than $350 per car per year on express refrigerators. The average life of either a freight refrigerator car or an express refrigerator car is approximatelv 12 yr., this figure being subject to some modification in the light of repairs or maintenance, etc. The initial cost of installing ice bunkers with the customary bulkheads is approximately $351 per car. The average maintenance cost of ice boxes and appurtenances, based on an actual maintenance expense record for a period of 39 mo., after January 1, 1926 is just about $50 per year per car owned. This figure would be the same for both freight and express refrigerator cars. As applied to freight refrigerator cars on basis of an estimated average af five trips per car per year under ice, this would indicate an average expense of $10 per car per trip for maintenance of ice bunkers and refrigerating devices belonging thereto.

Refrigerator cars are not only more expensive to build than ordinary steel underframe box cars, but the latter have a tare weight of about 5 tons less per car. Furthermore, the box car is practically an all-purpose car for which revenue loads in both directions are generally available. On the other hand, nearly half the total mileage of refrigerator cars is empty and in the direction of light traffic.

Governing Factors in the Transportation of Perishable Commodities

The third paper at the morning session was on the subject of "Governing Factors in Transportation of Perishable Commodities" and was presented by L. A. Hawkins. The best conditions, he said, for the transportation of foodstuffs are similar to those for the holding of foodstuffs for the longest possible time in good condition in cold storage. While a number of factors are concerned in furnishing the best conditions for storage or for the keeping of produce in good condition in transit, by far the most important factor is the temperature at which the produce is held. The best temperature for keeping the produce, he said, is not necessarily the lowest temperature at which it can be held without freezing, as in many cases injury to the commodity may occur at temperatures well above the freezing point. The problem of furnishing the best conditions for perishable foodstuffs in transit is largely a problem of cooling it down to the proper carrying temperatures as quickly as possible by removing the heat, then furnishing sufficient refrigeration or heat to keep it at a relatively constant temperature en route to market. With non-living commodities, the amount of heat to be removed can be calculated approximately, Mr. Hawkins pointed out, from the specific heat of the commodity. With fruit and vegetables, however, which are usually shipped in a living condition, the problem is further complicated by the fact that they give off considerable heat due to the vital processes of the living organism. This heat, he said, comes from the breaking down of complex chemical compounds and varies with the temperatures at which the produce is held, and with the various types of fruits and vegetables. It must be determined experimentally for each commodity at each different temperature and no direct method for the measurement of this heat has been developed as yet. Mr. Hawkins showed that it can be arrived at approximately by indirect methods, and he gave some data in his paper on the amount of vital heat given off by some fruits and vegetables at various temperatures.

Design of Railway Refrigeration Equipment

The afternoon session of the joint symposium was devoted to the general subject "Design of Railway Refrigeration Equipment." Frederick G. Grimshaw, works manager, Pennsylvania, Altoona, Pa., presided at this session. The first paper was entitled "Practice in Refrigerator Car Design," and was presented for the A. S. M. E. by E. A. Sweeley who pointed out that the development of the design of refrigerator cars has been based upon the theory of ice refrigeration, tempered by service requirements and experience. Various notions and patents have specified different types and locations of cooling media, but practice has more or less crystalized in the iced car with end bunkers, free air circulation and suitable insulation. The condition of the food as loaded, he said, its temperature and soundness, determine what its condition will be when unloaded, given proper icing on the trip. Boxes and crates should allow unobstructed circulation, and the partition between the car and ice compartment should be insulated.

Impetus for good construction, he pointed out, began with the U. S. Railway Administration's recommendations of 1918, which related mainly to full-type basket bunkers and to insulation, of which 2 in. was preferred for walls, 2½ in. for roof, 1 in. for bunkers. The three classes of cars commonly used are all-wood superstructure with all-steel underframes, steel superstructure with wood lining, sheathing, etc., and all-steel frame, and all-steel throughout. Only a few, he said, of the last

variety are used, and these are in passenger service, indicating their lack of popularity.

Mr. Sweeley stated that cars with the wooden superstructure are common. Post and brace casting pockets are used in this construction, with caps so arranged as to provide joint bearing surfaces for the entire width and thickness, which is an important development in design necessitated by weaving of the car and service shocks. Waterproofing the floors, he also pointed out, has been a problem in this work. Some shipments of green stuffs will melt as much as five tons of ice in the car itself, or 1,200 gal. of water. This is enough, he said, to make a pool 7 in. deep on the floor, much of which soaks into the floor itself. The prevention of absorption is, however, in an experimental stage. The roof is the front line of defense against heat in the summer and frost in the winter, and in its design account must be taken of keeping out cinders and dirt.

Heating, Mr. Sweeley stated, is required in certain sections of the country for a few months each year. Heaters are set on special grates in the bunkers or in the ice pans themselves, and the circulation they set up is the reverse of that resulting from the use of ice as the driving force. In heating service, he said, the danger to the product is from freezing, and is most liable to affect the bottom layer of goods. In summer, during cooling, danger to food is in spoilage which is most likely to take place in the top layer which gets the warmest air.

The Master Car System of Refrigerating Trains

The second paper of the afternoon session was presented for the A. S. R. E. by R. W. Waterfill, whose paper on Research Studies of Refrigerated Trains, described the "master car" system, the features of which include a train of refrigerator cars piped from brine circulation cooled from a master car which contains a compressor, condenser, brine coolers, a gasoline motor, and an electric generator and motor, cooling tower, etc. This master car cools brine for 50 refrigerator cars when properly piped up. Mr. Waterfill estimated 40 tons as the load required to hold 35 deg. F. in a train of perishables.

According to Mr. Waterfill's description, the master car uses an internal combustion engine to generate current to drive a centrifugal refrigerator compressor, the details of which he illustrated with lantern slides. It involves also a 100-gal. brine tank for storage, a 900-gal. water tank to provide coolant for the condensers, and a motor for 10-hr. operation. The brake horsepower of the compressor he estimated at 65 hp. in the example he used to illustrate the master car systems, with 111 hp. required from the internal combustion engine. One hundred gallons of brine are circulated per minute.

The individual cars, Mr. Waterfill said, may have brine coils at the ends, or along the top. Two circuits are used, one complete in the train as a whole, the other complete in each car. This secondary system provides holding capacity, larger cooling surface and cuts down the amount of brine that must be circulated throughout the entire length of the train. The master car should preferably be placed in the middle of the train.

The fixed charge on this equipment, he estimated, would run $7,750 annually for amortization, interest, supplies for the train considered and the master car. The operating cost would run about $54.20 a day. For a transcontinental trip, he said, the total cost might thus be expected to amount to $2,700, as compared to $4,800 for ice.

Both Mr. Waterfill's paper and the last paper of the afternoon session, which was on the subject of Recent Applications of Refrigeration for Precooling, were presented for the A. S. R. E. The final paper, prepared jointly by C. P. Goree, Jr., and L. R. Graves, stated briefly the need that has brought about the adoption of precooling, covered the earlier methods used and dealt in some detail with the present methods, the results accomplished and the construction of the present type of plant.

The paper referred to precooling conditions particularly in the southeast (citrus fruits) and the northwest (deciduous fruits). These two territories, the authors pointed out, have developed practices beyond all the others. Southern Texas and California will doubtless follow along, but at present precooling is not generally practiced in those sections. Other sections of the country producing perishables, it was stated in the paper, are in most cases within easy reach of their market, and do not produce quantities large enough to require holding over in storage season. The apple crops, according to the paper, in Virginia, Pennsylvania and western New York reach large volumes, but here the product is close to permanent storage, remaining there until removed for later consumption.

Exhibit Includes Two Refrigerator Cars

An additional feature of these two sessions on transit refrigeration work was the exhibition of two refrigerator cars, one of which was the property of the Safety Refrigeration, Inc., refrigerated by the silica gel process, and the other owned by the Fruit Growers Express Company and refrigerated by ice. An exhibit of refrigerating equipment was also held in the mechanical laboratory of the college, which included a gas liquifier presented to the college by the Linde Air Products Company, an air filtration apparatus exhibited by the Armstrong Cork & Insulation Company, and air-conditioning equipment exhibited by the Carrier Engineering Corporation.

An informal dinner was held Friday evening, at which President A. J. Wood acted as toastmaster. The principal address was made by G. D. Ogden, general traffic manager, Pennsylvania, Philadelphia, Pa., whose remarks were confined largely to recent developments in railroad transportation. Other speakers on the program were Ralph D. Hetzel, president of the Pennsylvania State College, and A. R. Stevenson, Jr., of the General Electric Company.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Joint Evidence Necessary to Claim Wrong Repairs When Changing Types of Couplers

On October 8, 1927, the Texarkana & Ft. Smith applied to Canadian Pacific car No. 211590 one new 5-in. by 7-in. Type D coupler in place of a 5-in. by 5-in. Sharon coupler, the head of which was broken. The Canadian Pacific refused to pay the bill, contending

that as set forth in Rule 17, Paragraph (C), Third Section, 5-in. by 5-in. couplers should be maintained in service as applied to cars handled in interchange service, setting forth that, if the owner desires to make a change in the design of the draft arrangement, it should make provisions for the application of a Type D, 5-in. by 7-in. or 6-in. by 8-in. coupler, but the third section of Rule 17 does not authorize the repairing line when removing a 5-in. by 5-in. coupler for repairs, to apply a Type D coupler simply on the ground that sufficient clearance exists for the 5-in. by 7-in. shank coupler. The repairing line contended that the car carried no stenciling to show the size of the shank standard to the car and that the opposite end of the car was equipped with a 5-in. by 7-in. coupler and that the draft sills had 13½ in. spacing, which was interpreted to mean that 5-in. by 7-in. couplers were standard to the car. The repairing line also contended that the owners should furnish joint evidence to show that 5-in. by 7-in. couplers were not standard so that positive evidence would be presented that a 5-in. by 5-in. coupler was required.

In rendering its decision, the Arbitration Committee stated that "The contention of the Canadian Pacific is not sustained. If wrong repairs were made the owner should obtain joint evidence."—*Case No. 1590—Canadian Pacific vs. Texarkana & Fort Smith.*

Basis for Computing Depreciation on Destroyed Car

Georgia car No. 15009, a 50-ton wood gondola, equipped with metal draft arms with railroad rails used for center-sills stiffeners and for side stakes, was destroyed by the Cleveland, Cincinnati, Chicago & St. Louis on April 10, 1927. The valuation statement furnished by the Georgia reported the car under Class E of Rule 112, built September, 1924, and the depreciated value to be $1,606.80. The C. C. C. & St. L. questioned the date the car had been built since the body bolster on the "A" end showed the date cast "Geo. R. R. 9-07" and the body bolster on the "B" end showed "G. A. R. R. 9-07" which was evidence that the bolsters were originally used on cars built at that time and, therefore, that should be the date from which to compute the depreciation on the destroyed car. The owner admitted the facts set forth by the handling line, but stated it was impossible to determine from what car or from what age of car any item of second-hand material used in car No. 15009 was salvaged. Since it was not possible to determine the age of the second-hand parts, the Georgia suggested settlement on the basis of 80 per cent of the reproduction costs.

In rendering its decision, the Arbitration Committee stated that "In such case where the owner is unable to determine the original date built for settlement purposes, the maximum depreciation applicable to the class of car shall govern."—*Case No. 1591—Cleveland, Cincinnati, Chicago & St. Louis vs. Georgia Railroad.*

Stenciling as to Date Built or Rebuilt to Govern Charge for Change of Triple Valves

On August 30, 1927, St. Louis-San Francisco car No. 125109 was on the repair tracks of the Southern Pacific for minor repairs. The repairing line found the car stenciled for a K-2 triple valve on one side of the car and an H-1 New York triple valve on the opposite side and that there was an H-1 New York triple valve on the car. The Southern Pacific removed the H-1 triple valve and applied a K-2 valve and also stenciled the car on both sides to show the K-2 type of valve standard to the car. The owner took exception to the charge of $31.25 rendered by the repairing line for doing this work, claiming that the repairing line had erred in removing the H-1 triple valve as the air brakes were not given annual attention, the triple valve was not defective and the date built permitted the interchange of the car with a triple valve other than an A. R. A. Standard K-1 or K-2. The air brakes on this car had last been given attention by the Chicago Great Western on November 25, 1926, the repair card showing that an H-1 triple valve had been removed and applied. The repairing line maintained that the owner should pay for the change because it was considered a betterment.

The Arbitration Committee stated that "The conditions were not such as to warrant the Southern Pacific making the exchange of triple valves. The bill against the owner for a triple valve is not sustained."—*Case No. 1593—St. Louis-San Francisco vs. Southern Pacific.*

Responsibility for Reloading Cars Before Repairs Were Made

Chicago, Milwaukee & St. Paul car No. 36663, was moved by the Baltimore & Ohio Chicago Terminal to the Chicago & Alton lines on April 18, 1925, at which time a defect card was issued against the B. & O. C. T. for six side stakes broken and one top side-plank raked new, and sideswiped. The car was moved home empty and was repaired by the owner on September 3, 1925, and a bill rendered against the B. & O. C. T. The latter secured a defect card against the C. & A. reading, "to offset card issued April 18, 1925, Baltimore & Ohio Chicago Terminal to Chicago & Alton, account car reloaded," which defect card was used by the B. & O. C. T. to bill the C. & A. to offset the Chicago, Milwaukee & St. Paul repair bill.

Chicago, Milwaukee & St. Paul car No. 63743, was moved by the B. & O. C. T. to the C. & A. lines on November 24, 1925, at which time a defect card was issued against the B. & O. C. T. for 19 floor planks and two intermediate sills broken new, two metal cross ties bent new, A. R. & A. L., by loading machinery. This car was repaired by the Union Pacific on February 27, 1926, and a bill rendered against the B. & O. C. T. which protested the charge and secured a defect card on June 17, 1926, against the C. & A. reading, "to offset the card issued on November 24, 1925, Baltimore & Ohio Chicago Terminal to the Chicago & Alton, because of the car being reloaded," which defect card was used by the B. & O. C. T. to bill the C. & A. to offset the Union Pacific repair bill.

The C. & A. protested the issuance of the offset defect card because of the failure of the owners to repair the car before reloading, and because it had neither participated in the repairs nor caused the damage to the car. Because the Chicago Car Interchange Bureau refused protection, the C. & A. took the cases up with the owners and was advised that it had presented a similar case to the Arbitration Committee and requested that this be held in abeyance until decision was rendered. The B. & O. C. T. declined to cancel the offset cards, claiming that the C. & A. had not handled the claim within the 60-day limit of the A. R. A. Rule 91.

In rendering its decision, the Arbitration Committee stated that "The contention of the Chicago & Alton is sustained. The offset defect cards should be canceled."—*Case No. 1594—Chicago & Alton vs. Baltimore & Ohio Chicago Terminal.*

How the Missouri Pacific Handles Alloy Steel

Proper forging and heat treating methods plus modern equipment result in maintenance economies and reduction of defects

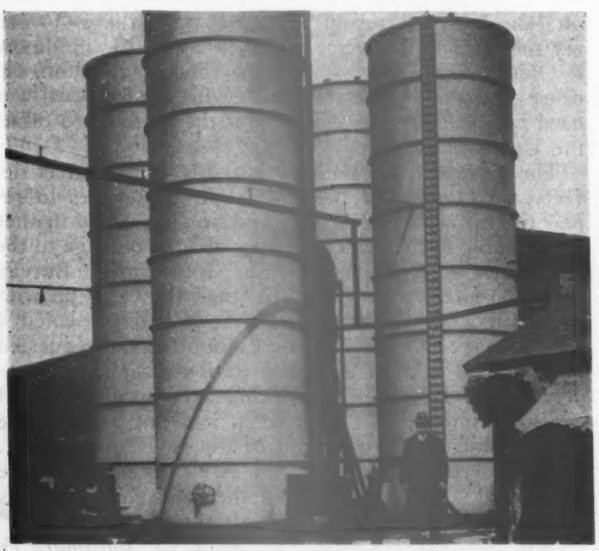
ABOUT four and one-half years ago the Missouri Pacific adopted alloy steel for certain locomotive parts and in order to assure the complete success of the use of this material the forge shops were equipped with up-to-date equipment for forging and heat treating the parts and an experienced steel man placed in charge of the work in order that the entire operation would be conducted in accordance with the best of accepted modern alloy-steel practice.

The railroad specifications for locomotive driving axles, crank pins, piston rods and main rods call for the use of carbon-vanadium steel having chemical and physical properties as shown in the table.

Locomotive crosshead keys are made from chrome-vanadium steel. Steam-pipe bolts, superheater-header bolts, superheater-unit bolts and nuts, exhaust-nozzle bolts and studs are manufactured from chrome-nickel steel. The specifications for these steels are shown in tables.

Inasmuch as the greatest part of the forging work on alloy steel is in connection with the manufacture of locomotive driving-rod forgings, most of the information in this article will deal with the equipment and the methods used in forging and heat treating these parts at the Sedalia, Mo., and North Little Rock, Ark., shops where all of this work is concentrated.

Next to a trained personnel, the most important factor in the successful production of alloy-steel forgings is the provision of the proper facilities. At both of the points mentioned the forge shops have been equipped with modern forging and heat-treating



Storage tanks for fuel oil supply for the shops

Locomotive crank pins on the furnace car after removal from the heat treating furnace

Chemical and Physical Properties of Alloy Steel for Driving Axles, Crank Pins, Piston Rods and Main Rods

CHEMICAL PROPERTIES

Carbon, per cent	0.45 to 0.55
Manganese, per cent	0.70 to 0.95
Phosphorus, per cent	not over 0.045
Sulphur, per cent	not over 0.050
Vanadium, per cent	minimum 0.18

(a) An allowance of plus or minus .02 per cent in carbon will be permitted on check analysis.

(b) Owing to the recognized difficulties in the chemical determination of vanadium, an allowance of .03 per cent minus will be permitted on check analysis.

(c) Chromium, as an impurity, will be permitted up to a maximum of 0.25 per cent.

TENSILE PROPERTIES

Size	Yield point, lb. per sq. in.	Tensile strength, lb. per sq. in.	Elongation in 2 in.	Reduction of area
Up to 5 in. diam. or thickness	60,000	90,000	20 per cent	40 per cent
5 in. to 9 in. diam. or thickness	60,000	90,000	20 per cent	40 per cent
9 in. to 13 in. diam. or thickness	58,000	90,000	20 per cent	40 per cent

(b) The classification by size of the forging shall be determined by the specified diameter or thickness which governs the size of the prolongation from which the test specimen is taken.

(c) The yield point shall be determined by the drop of the beam of the testing machine.

Chemical Properties of Chrome-Vanadium Steel for Crosshead Keys

Chemical Composition: The steel shall conform to the following requirements as to chemical composition:

Carbon, per cent	0.25—0.35
Manganese, per cent	0.50—0.80
Phosphorus, max. per cent	0.04
Sulphur, max. per cent	0.04
Chromium, per cent	0.80—1.10
Vanadium, min. per cent	0.15—0.18 desired

Forging main rods under the 5,000-lb. steam hammer

furnaces of the type shown in the accompanying drawings. These furnaces are oil-fired and fuel oil is piped throughout the forge shop directly from storage tanks. The fuel supply system is equipped with a heater system to maintain the fluidity of the low grade fuel oil used at winter temperatures below zero. The average analysis of the fuel oil is as follows:

Gravity at 60 deg. F.	18.6 Baumé
Flash point, open tester	216 deg. F.
Fire point, open tester	305 deg. F.
Viscosity at 122 deg. F.	24 sec. (Saybolt)

All of the forging and heat-treating furnaces in which alloy steels are handled are equipped with pyrometers and on the heat-treating furnaces the equipment consists of recording pyrometers in conjunction with automatic temperature control.

Selecting the Proper Billet

In order to minimize waste of material, a great deal of care has been taken to determine the exact size of billet needed for the different jobs. Particularly in the manufacture of rod forgings, billet specifications and ordering charts have been drawn up showing the locomotive classification, the drawing reference, the proper billet size and the billet number. In ordering billets from the steel manufacturer they are ordered finished to these several sizes and on each billet is stamped the manufacturer's name, the kind of material, the order number, heat number and billet number. This identification marking is also stamped on the finished parts in order that any subsequent defects or failures in service may be traced to the specific material from which it was manufactured.

In the manufacture of locomotive main rods the forging billets suitable for the manufacture of rods for 35 different classes of locomotives have been reduced to 12 standard sizes, varying from 5-½ in. by 18 in. by 55 in. to 10 in. by 20 in. by 55 in. in size. One of the illustrations shows the finished outside dimensions of a large main rod and an intermediate side rod and the billet size from which it is manufactured.

Preparations for Forging

It is considered a most important factor in rod forging to preheat the billets before they are actually raised to the proper forging temperatures in order to minimize the possibilities of internal ruptures. Particularly during the winter months, when outside temperatures may be unusually low, the practice is to bring the billets into the forge shop from the outside storage space and place them near the furnaces in the shop for what is termed a shop warming period. The billet is left near the furnaces for from 10 to 12 hours in order that its temperature throughout may be raised to the temperature of the shop.

The proper preheating time depends, of course, upon

Rod billets are ordered cut to the exact size required

the size of the billet. A billet of the size used for manufacturing the main rod shown, namely, 9 in. by 20 in. by 50 in., should have at least 4-½ to 5 hours preheating time. Some forging furnaces are designed with a preheating chamber, but those in use at the Sedalia shops at the present time are four-door forging furnaces without a preheating chamber. In order, therefore, to preheat the billets without consuming any of the shop working time, the billets that are to be used for the next day's forging operations are placed in the furnaces at the end of a working day after the furnace has been shut down and are thus allowed to absorb the furnace heat during a 12-hour period from 4 p. m. to 4 a. m. The temperature of the billets at the end of the preheating period is in the neighborhood of from 700 to 1,000 deg. F. At 4 a. m. the furnaces are fired and the temperature raised gradually during the four-hour period between then and 8 a. m. to from 1,900 to 2,100 deg. F. The time elements mentioned here refer to the size billet previously mentioned for main rods. Both the preheating time and the time required to raise to forging temperatures would naturally be more or less with smaller or larger billets than the size already mentioned in the text of this article.

Rod Forging

The practice of the Missouri Pacific on rod forging

Specifications of Steel for Steam-Pipe and Superheater Bolts and Nuts

CHEMICAL SPECIFICATIONS

The steel in the bolts and studs shall conform to the following requirements as to chemical composition.

Carbon, per cent	0.25 to 0.35
Manganese, per cent	0.50 to 0.80
Phosphorus, per cent	Max. — 0.04
Sulphur, per cent	Max. — 0.045
Nickel, per cent	1.00 to 1.50
Chromium, per cent	0.45 to 0.75

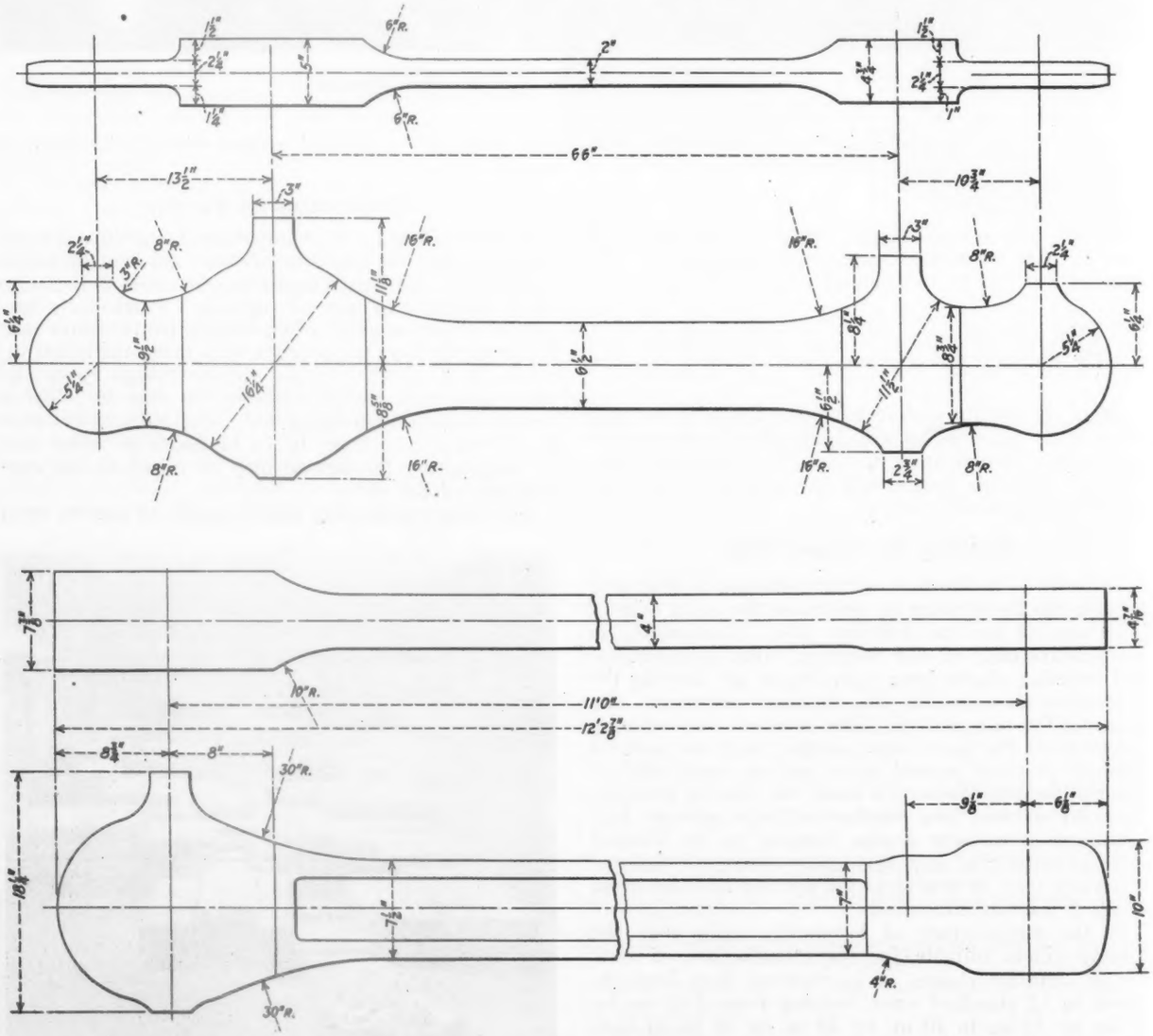
PHYSICAL PROPERTIES AND TESTS

The finished bolt or stud shall conform to the following requirements as to tensile properties:

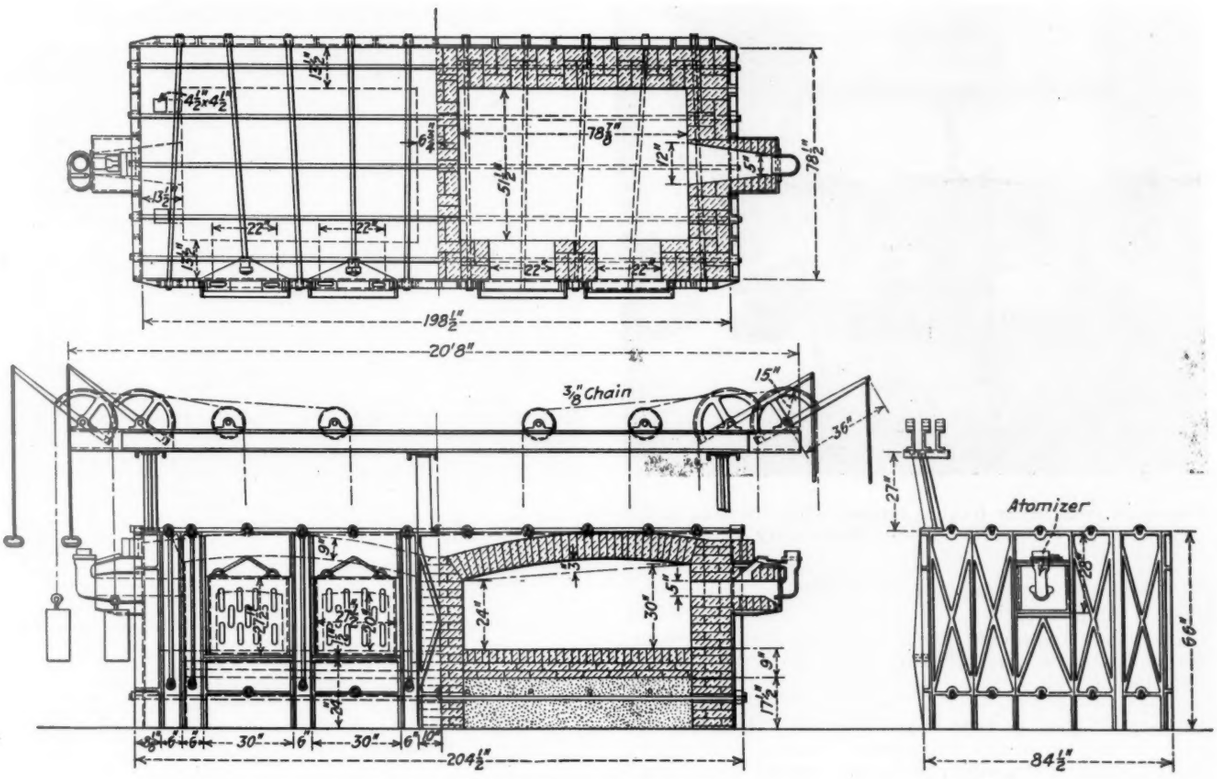
Tensile Strength, lb. per sq. in.	Not less than 110,000
Elastic limit, lb. per sq. in.	Not less than 90,000
Elongation, in 2-in. per cent	Not less than 18
Reduction of area, per cent	Not less than 50

Bend Tests: (a) The bolt shank or stud shall be bent cold, also hot at a temperature of 1000 deg. F., under the hammer or by pressure, around a pin whose diameter is equal to the bolt or stud, without cracking on the outside of the bent portion.

(b) The head of the bolt shall be free from harmful cracks resulting from upsetting and shall stand being bent backward in the same proportion as the body without splitting off.



Drawings showing the dimensions of finished side rods; Above—Billet No. 19 forged from a billet 7 in. by 20 in. by 50 in.; Below—Billet No. 30 forged from steel 9 in. by 20 in. by 50 in.



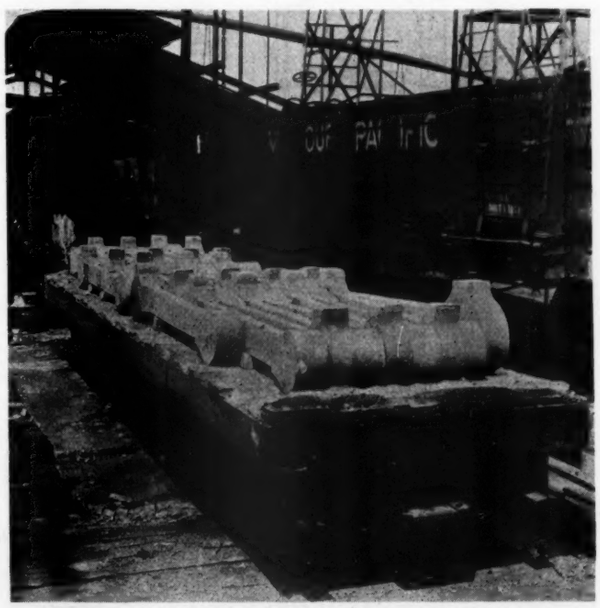
Type B forging furnace

has been changed materially within the last four years as a result of the introduction of alloy steel and also from experience with previous methods which did not permit production at the desired rate of output. Prior to January, 1926, the average time required to produce one rod under conditions existing at that time was from 12 to 16 hours. Under the old methods the billets used sometimes varied from 10 to 20 ft. in length which required cutting into smaller lengths, usually by means of an acetylene torch. The change to billets of a size suitable for forging single rods has eliminated the difficulty of handling the longer billets as well as the expense of cutting to length. Under former conditions the rods were put through three heats in a two-door furnace, only one door of which could be used at a time. It was necessary to make the three heats in order to draw the rod out to its proper length. It was then placed on a coal fire for heating preparatory to forging the rod ends. About January, 1926, preheaters were applied to the furnaces and it was then possible to use both doors on the furnaces, thereby increasing the output from one rod in from 12 to 16 hours to two rods in eight hours. In July, 1926, the present type of four-door forging furnaces were installed, which increased the daily output from two rods a day to four and eight rods a day.

Heat Treatment of the Forgings

The increase in output has been made possible by the installation of the larger, more modern furnaces and by the fact that the forging billets are now ordered to the exact size required, thereby effecting not only a great saving in time but a saving in the material that is wasted by excess stock being left in the forgings to be machined off. On the average rod forging using billets of the proper size, as shown by the ordering schedule, there is an average of less than 10 per cent waste material in trimming the forgings.

After the forging work on the rods has been completed the rods are taken to the heat-treating furnaces for the final treatment. The heat-treating furnace shown in one of the illustrations is a car-bottom furnace which is temporarily located outside of the forge shop. This furnace is oil-fired and is equipped with the Brown Instrument Company's recording pyrometer and automatic temperature control designed to maintain furnace tem-



Side- and main-rod forgings after the heat treatment is completed

Four-door two-burner forging furnace—This furnace is also used for preheating the billets preparatory to forging

peratures within a range of 10 to 20 deg. at the heat-treating temperature.

The heat treatment for carbon-vanadium main and side rods, piston rods, driving axles and crank pins is as follows:

Normalize—Heat to 1,650 deg. F., allowing eight hours to bring the rods up to this temperature. Hold at this temperature for eight hours, after which the forgings are removed from the furnace and allowed to cool in still air to a temperature of about 500 deg. During the cooling period the forgings should be protected from contact with rain, snow or a strong draft. (A sheet metal box provides desirable protection.)

Anneal—Reheat to 1,150 to 1,250 deg. F., allowing eight hours to reach this temperature, and then hold the temperature for a period of eight hours. After the expiration of the eight-hour period the forgings are removed from the furnace and allowed to cool in the same manner as above.

Summary of Methods and Time Required

METHOD USED IN 1925 ON MAIN AND SIDE RODS
Equipment: Two two-door furnaces (Only one door used)
One 3,300-lb. steam hammer

No. men	Time each	Man-hours
1 Blacksmith	13½	13.5
1 Blacksmith	9	9.0
1 Heater	15½	15.5
2 Helpers	13½	27.0
4 Helpers	9	36.0
Total		101.0

The above time was required to forge one main rod or side rod.

METHOD USED FROM JANUARY 1, 1926, TO JULY 1, 1926
Equipment: Two two-door furnaces with preheaters (Both doors used)
One 3,300-lb. steam hammer

No. men	Time each	Man-hours
1 Blacksmith	8	8.0
1 Blacksmith	8	8.0
1 Heater	8	8.0
2 Helpers	8	16.0
4 Helpers	8	32.0
Total		72.0

The above time was required for the forging of two rods, or an average of 36 man-hours per rod.

METHOD USED FROM JULY, 1926 TO DATE
Front and Back Side Rods
Equipment: One four-door two-burner furnace
One 3,300-lb. steam hammer

No. men	Time each	Man-hours
1 Blacksmith	8	8.0
1 Heater	8	8.0
1 Hammer Operator	8	8.0
3 Helpers	8	24.0
Total		48.0

With this equipment and time the average is one rod an hour—eight a day

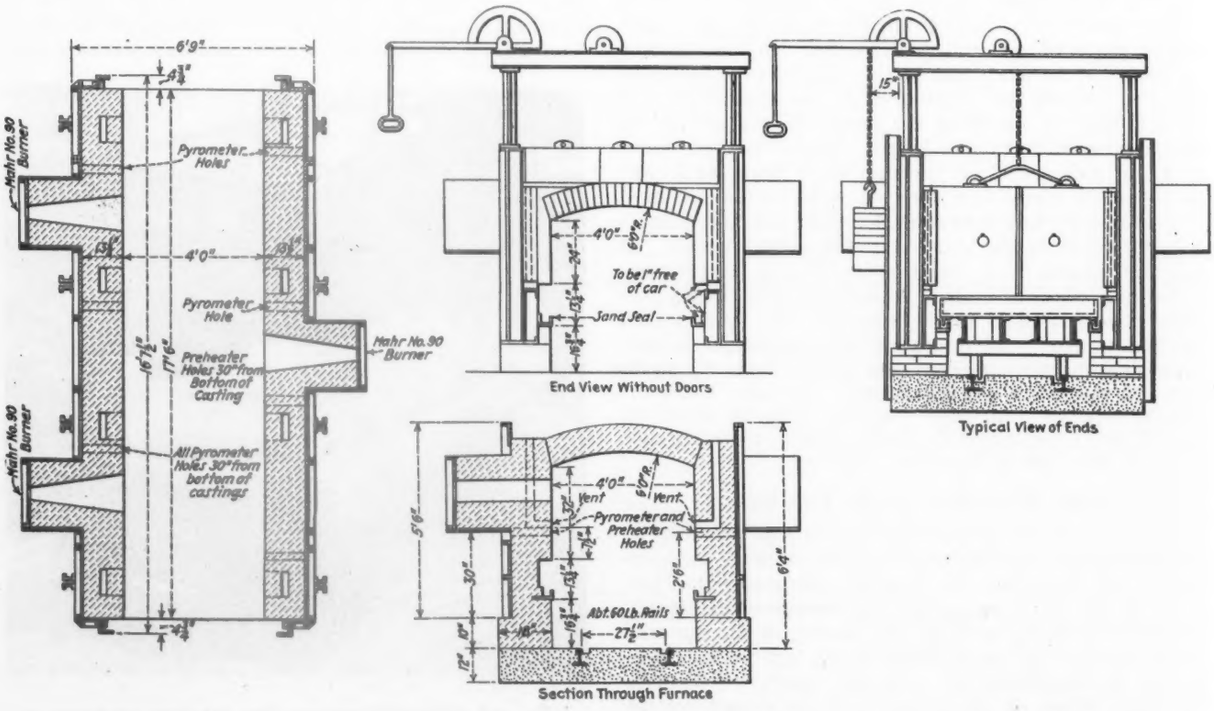
MAIN RODS AND LARGE INTERMEDIATE SIDE RODS
Equipment: One four-door two-burner furnace
One 5,000-lb. steam hammer

No. men	Time each	Man-hours
1 Blacksmith	8	8.0
1 Heater	8	8.0
1 Hammer Operator	8	8.0
3 Helpers	8	24.0
Total		48.0

With the above equipment and time the average production is one rod each two hours or four a day.

The heat treatment for superheater bolts and other small parts manufactured from chrome-nickel steel is as follows:

Normalize after forging at a temperature of 1,650 deg. F. and allow to cool slowly in air.



Car-bottom annealing furnace

A group of completed rod forgings

Final Treatment—Heat to 1,525 deg. F. and quench in water. Draw to 900 deg. F. for one hour and allow to cool in a dry place.

Conclusion

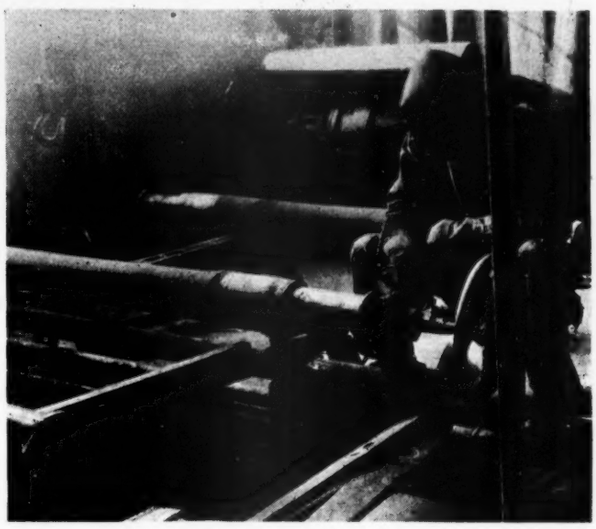
In a table will be found a summary of the methods and equipment used for forging main and side rods during the past four years and included in the table will be found the actual time worked by workmen of the different classifications and the man-hours required for forging the rods. It will be noticed that, owing to a change in methods and the installation of modern equipment, the number of men in the rod forging gangs has been reduced from nine men in 1925 to six men in 1928 and the time required to produce one rod has been reduced from an average of over nine hours to an average of one and two hours, depending on the size. The actual man-hours required per rod has been reduced from 101 in 1925 to 6 and 12 at the present time, depending upon the rod size.

Building Up Car-Journal Collars

WHEN it is necessary to build up car-journal collars by welding, a means should be provided to turn the axle easily as the welding progresses. With the arrangement shown in the illustration one man can turn an axle without difficulty during the welding operation.

A section of old rail, a few inches longer than the standard axle, has a section of 1-in. by 4-in. steel bolted to each end. These extend vertically about 8 in. above the rail. A solid center is welded to the inner side of one of these supports. A large nut is welded to the outer side of the opposite upright. A square-thread center with a brake wheel attached to the opposite end, passes through the nut and the upright bar into the center hole in the end of the axle. The other axle center is placed over the dead center and proper tension is applied by the hand wheel. The axle can then be easily revolved on the centers by one hand as the work progresses.

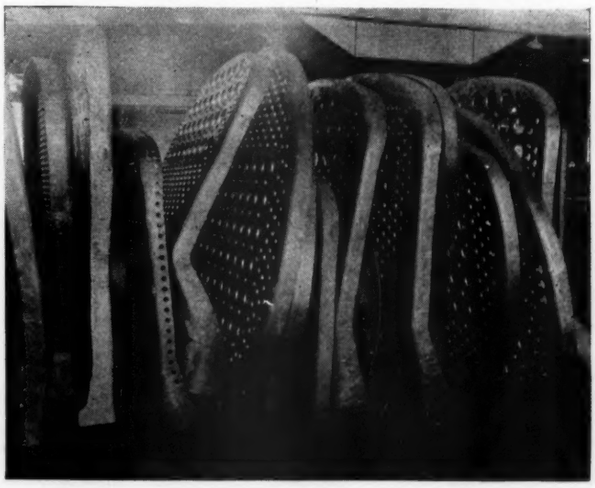
A number of the axles are placed on a track outside of the welding booth, which is made of two sections of rail placed on blocks. The axles are rolled down these rails to the device as needed. An overhead air hoist assists the welding operator to place the axles on the centers. After the welding is completed, the axles are rolled onto a pair of metal horses, shown at the rear of the welder, to be taken away.



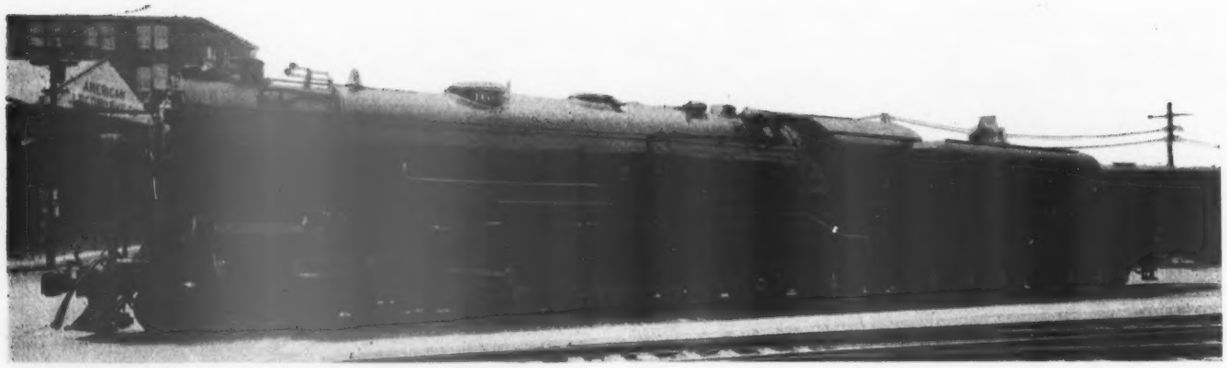
An arrangement which makes it easy for a welder to manipulate car axles

Storing Boiler Heads

NUMEROUS racks and devices have been originated in railway shops to prevent littering up the floor with material. The illustration shows a rack in which the cumbersome boiler heads are placed on end. In this position the heads take up little space and are easy to get at when needed. The rack is made of two 12-ft. sections of scrap plate, 14 in. wide, set edgewise about 3 ft. apart and held together by several stay-bolts. The boiler heads are placed edgewise in slots cut in the plates.



Boiler-head storage rack that requires little space



Delaware, Lackawanna & Western 4-8-4 type locomotive built for fast freight service by the American Locomotive Company

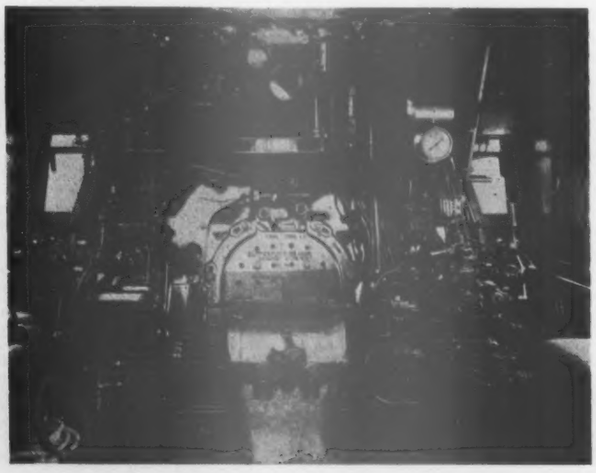
4-8-4 Type Locomotives for the Lackawanna

Construction of cylinder boiler-fit permits locating steam pipes completely within the smokebox

By S. S. Riegel
Mechanical Engineer, Delaware, Lac kawanna & Western, Scranton, Pa.

A TOTAL of 20 4-8-4 type locomotives are now operating in fast-freight service between Buffalo, N. Y., and Hoboken, N. J., the design of which possesses many of the characteristics of the five locomotives of the same type which were placed in heavy limited passenger service by that road the latter part of 1927.* The new locomotives, which are known on that road as the Pocono type, were recently built by the American Locomotive Company. They have 28-in. by 32-in. cylinders, 70-in. driving wheels and the boiler operates at a pressure of 235 lb. The maximum tractive force is 71,600 lb. The total weight of one of these engines is 418,000 lb., of which 262,000 lb. is carried on the drivers. The trailer truck is designed to permit the application of a booster.

* A description of the D. L. & W. 4-8-4 type passenger locomotive appeared in the January, 1928, *Railway Mechanical Engineer*, page 5.



Interior view of the cab

Operating in Fast Freight Service

These locomotives are operating in scheduled freight service and are designed to haul trains of 2,230 tons the entire distance between Buffalo and Hoboken, at a scheduled speed of from 20 to 25 m. p. h. and at a maximum speed of 60 m. p. h. over level track, except on the 1.7 per cent grade from Scranton, Pa., to Pocono Summit, where helper service is provided. According to estimates made by the mechanical department of the railroad, the handling of full tonnage trains with these locomotives will require the evaporation of 450,000 lb. of water and the burning of 75,000 lb. of coal while en route.

Twelve-wheeled tenders, with a water capacity of 15,000 gal. and a fuel capacity of 22 tons, are provided. The entire locomotive with under-structure is a single cast-steel bed plate made by the Commonwealth Steel Company, Granite City, Ill., consisting of the cylinders, frames, front bumpers, coupler pockets, guide cross braces, frame cross braces, cradle frame, truck and trailer guide supports, rear bumper, drawbar pockets, and bumper beams. This makes the entire under-frame of the locomotive a rigid structure, which should remain

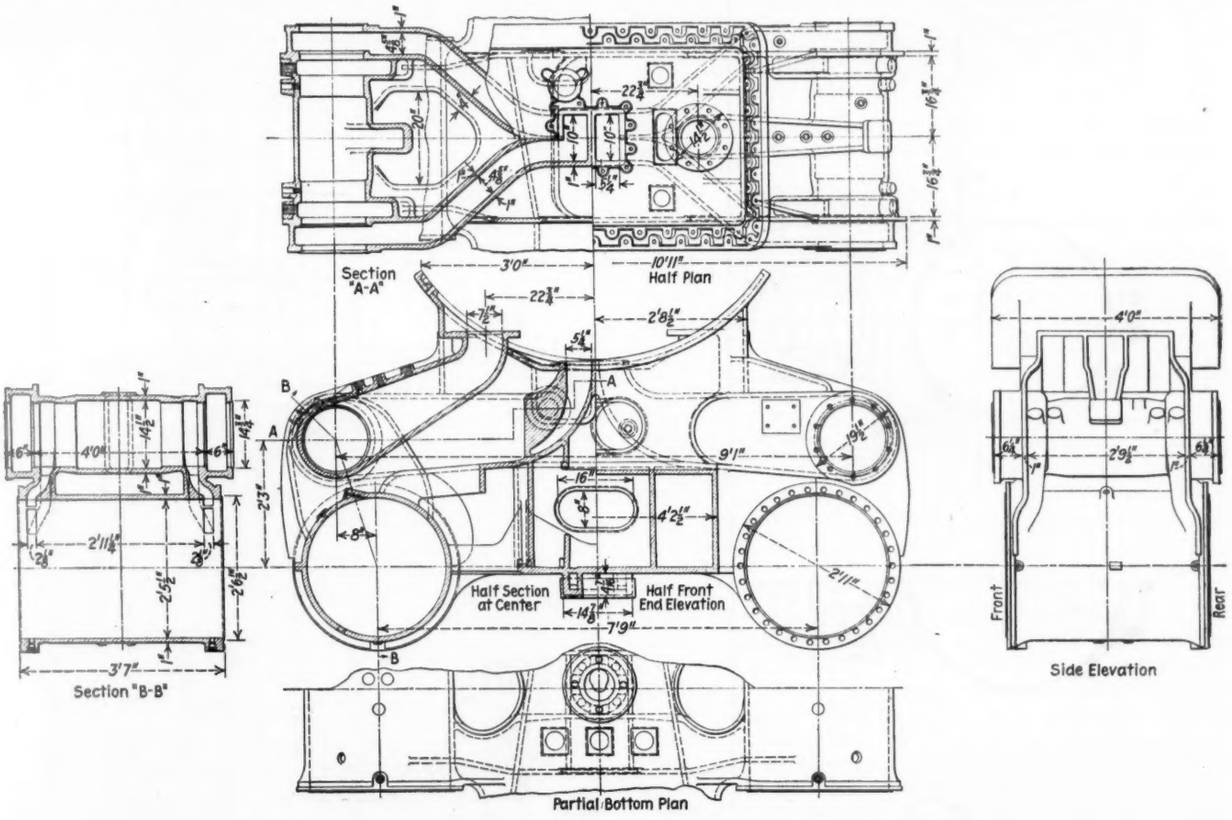
intact without difficulty for the life of the locomotive and effect a maintenance saving at shoppings.

The Cylinder Construction

The construction at the cylinder boiler-fit is a departure from customary practice in which the saddle is widened to permit placing the steam pipes which lead from the superheater-header connections to the cylinders completely within the smokebox. This eliminates outside steam pipes, which customarily pass through openings in the sides of the smokebox. With this arrangement, all steam and air joints are avoided, which insures tight smokeboxes and overcomes the maintenance difficulties of the old arrangements.

Similarly, the engines have one-piece Commonwealth engine- and trailer-truck frames of unit cast-steel construction. This provides rigid truck frames capable of withstanding the service expected from them. The water-bottom tender frame is also a Commonwealth unit casting of such design that the tank chamber is riveted to it and sealed by welding.

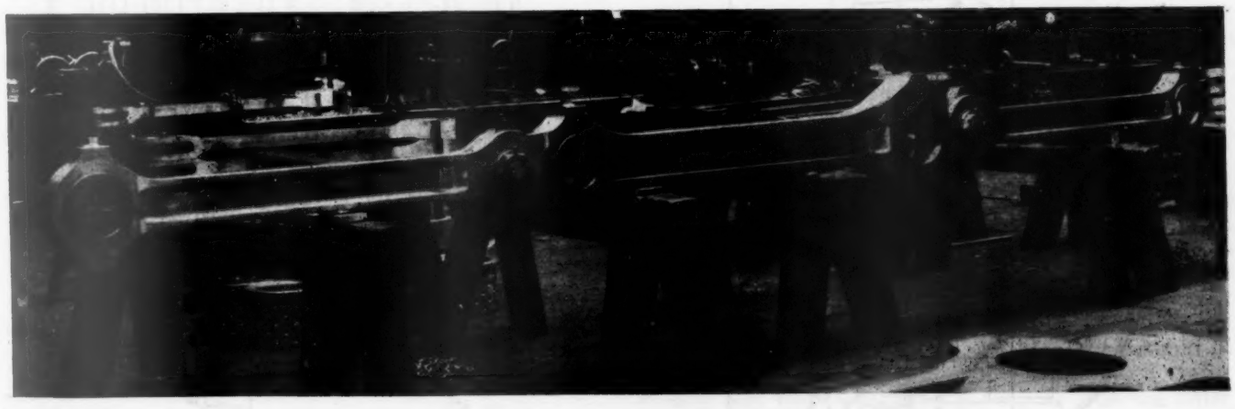
The tender trucks, which are of the six-wheeled type, also have Commonwealth frames of cast-steel one-piece structure. This makes these locomotives, which are the most powerful high-speed freight locomotives this company has ever had in service, the most durable and pleasing arrangement that it seems possible to build.



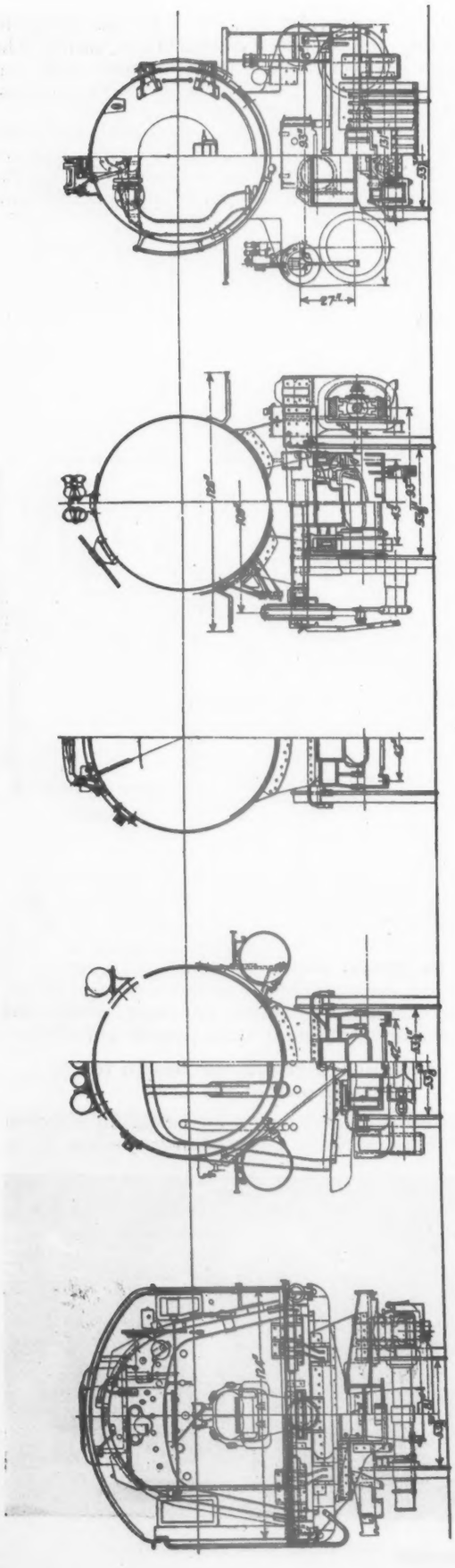
Drawing showing the construction of the cylinder casting

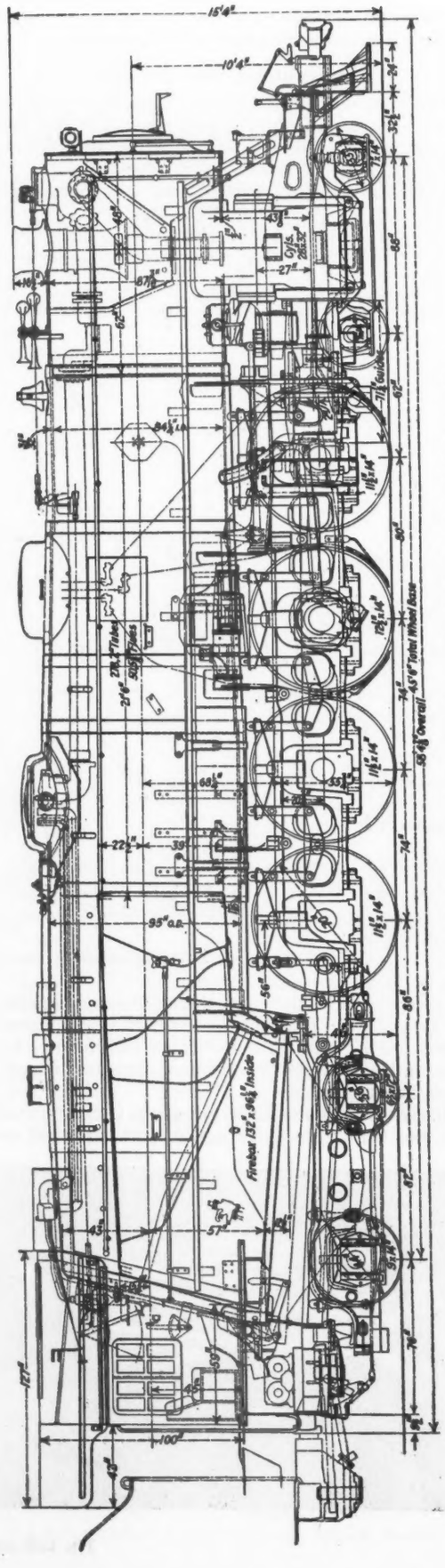
Attention Given in the Design to Convenience of the Crew

The locomotives were built to specifications prepared by the railroad company. Special attention was given



The side and main rod assembly



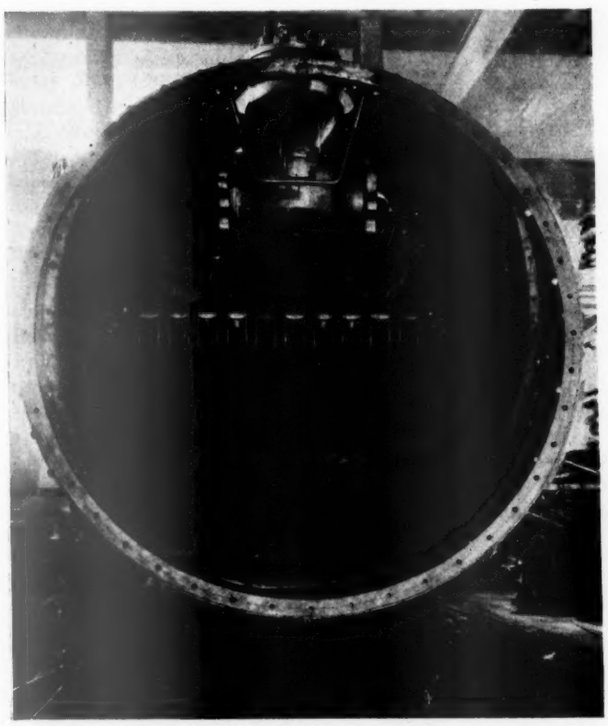


Elevation and cross-section drawings of the Lackawanna 4- 8-4 type locomotive built for fast freight service

by the designers to provide both convenient and economical operation, as well as to provide a neat and pleasing appearance. Lackawanna standard parts, such as pistons, piston heads, crossheads, driving boxes and main and side rods, were used in the design as far as possible. The main and side rods are nickel steel. The locomotives are equipped with mechanical force-feed lubricators which deliver oil to the valves and cylinders, air compressors, stokers, drifting valve and guides. Bradford balanced smoke-box type throttles are located so that, when starting, steam is delivered direct from the superheater to the cylinders by the shortest possible route. With this arrangement, superheated steam is available at the instant the throttle is opened and there is a minimum loss of steam during periods the engine is not working. The designers went to considerable pains in the selection and location of various devices, valves and fittings so that the engineman and fireman could operate them conveniently. The cab windows are provided with windshields to protect the engineman's vision, especially during inclement weather and also to shield his eyes from wind and dust. All twenty locomotives are equipped with Union Switch & Signal automatic train-control mechanism for operation between Buffalo and Scranton.

Table of Dimensions, Weights and Proportions of the D. L. & W. 4-8-4 Type Locomotives for Fast Freight Service

Railroad	Del., Lacka. & West.
Builder	American Loco. Co.
Type of locomotive	4-8-4
Service	Fast freight
Cylinders, diameter and stroke	28 in. by 32 in.
Valve gear, type	Walschaert
Valves, piston type, size	12 in.
Maximum travel	9 in.
Outside lap	1¾ in.
Exhaust clearance	None
Lead in full gear	3/16 in.
Weights in working order:	
On drivers	262,000 lb.
On front truck	65,500 lb.
On trailing truck	90,500 lb.
Total engine	418,000 lb.
Tender	289,000 lb.
Total engine and tender	707,000 lb.
Wheel bases:	
Driving	19 ft.
Total engine	45 ft. 6 in.
Total engine and tender	84 ft. 7½ in.
Wheels, diameter outside tires:	
Driving	70 in.
Front truck	33 in.
Trailing truck, front	36 in.
Trailing truck, rear	44 in.
Journals, diameter and length:	
Driving, main	12½ in. by 14 in.
Driving, others	11½ in. by 14 in.
Front truck	7 in. by 14 in.
Trailing truck, front	6½ in. by 12 in.
Trailing truck, rear	9 in. by 14 in.
Boiler:	
Type	Extended wagon top
Steam pressure	235 lb.
Fuel, kind	Bituminous
Diameter, first ring inside	84¾ in.
Firebox, length and width	132 in. by 96¼ in.
Combustion chamber, length	66½ in.
Tubes, number and diameter	278—2 in.
Flues, number and diameter	50—5¾ in.
Length over tube sheets	21 ft. 6 in.
Grate area	88.2 sq. ft.
Heating surfaces:	
Firebox and combustion chamber	377 sq. ft.
Syphons	27.5 sq. ft.
Tubes and flues	110.5 sq. ft.
Total evaporative	4,621 sq. ft.
Superheating	5,136 sq. ft.
Combined evaporative and superheating	1,324 sq. ft.
Tender:	6,460 sq. ft.
Water capacity	15,000 gal.
Fuel capacity	22 tons
Wheels, diameter outside tires	36 in.
Journals, diameter and length	6½ in. by 12 in.
Maximum tractive force	71,600 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	62.6
Weight on drivers ÷ tractive force	3.66
Total weight engine ÷ comb. heat. surface	64.7
Boiler proportions:	
Tractive force ÷ combined heat. surface	11.8
Tractive force × diam. drivers ÷ comb. heating surface	776
Firebox heating surface, per cent of evap. heating surface	7.35
Combined heating surface ÷ grate area	73.4



Interior of the smoke box

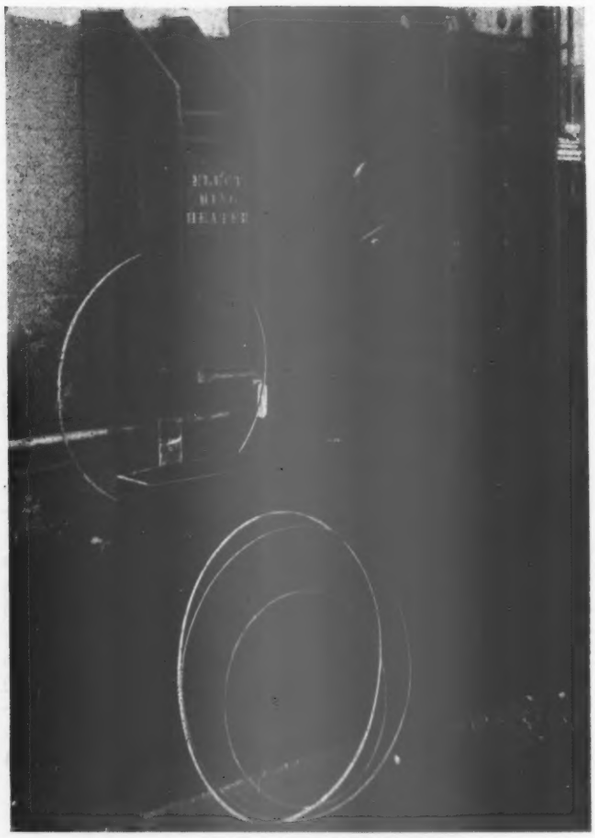
Special Equipment

The new locomotives are equipped with Standard BK stokers, Type A superheaters and Thermic syphons, two of which are located in the firebox and one in the combustion chamber. They are equipped with Westinghouse Pneuphonic horns. This is a quadruple horn or whistle arrangement, which gives a blended tone of great carrying capacity, one that is not only pleasing to the ear, but of maximum usefulness.

All the locomotives are equipped with the Lackawanna standard lateral-motion device which is applied to the front driving boxes. Ten of the locomotives are equipped with Nathan and ten with Detroit force-feed lubricators. Other special devices with which these locomotives are equipped are Cleveland low-water alarms and Alco power reverse gears. The principal dimensions, weights and proportions are given in the table.

Electric Ring Heater

A GREAT saving in the cost of annealing the copper gaskets used for sealing the cylinder head or dome caps of a steam locomotive has been made in the Battle Creek, Mich., shop of the Grand Trunk Western by the design of a special transformer to heat the rings electrically. These rings must be annealed in order to provide a tight seal. Prior to the design of the transformer, the annealing process was carried out in a coke fire which did not give a uniform product. It was decided to try a transformer in which the ring would be used as a single-turn secondary. Accordingly a transformer was built with a hinged leg so that the latter could be raised and the copper ring inserted. The pri-

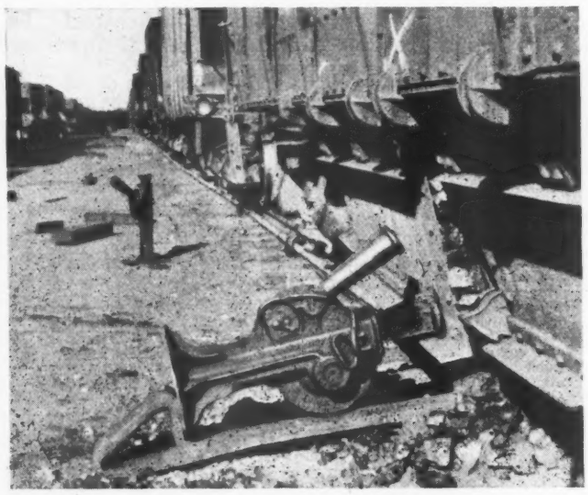


An electric ring heater used in the Grand Trunk Western shops at Battle Creek, Mich.

mary of the transformer is wound for 440-volt operation. Soon after the safety switch is closed, the ⅜-in. copper ring begins to assume a cherry red color and in a few seconds reaches the correct temperature. The switch is then opened and the ring allowed to cool slowly, or it may be dropped into the rectangular tank shown below the heater to obtain the proper annealing action. The current consumption per ring heated costs about one-tenth of a cent, based on an energy rate of two cents per kilowatt-hour.

Device for Jacking Car Hopper Doors

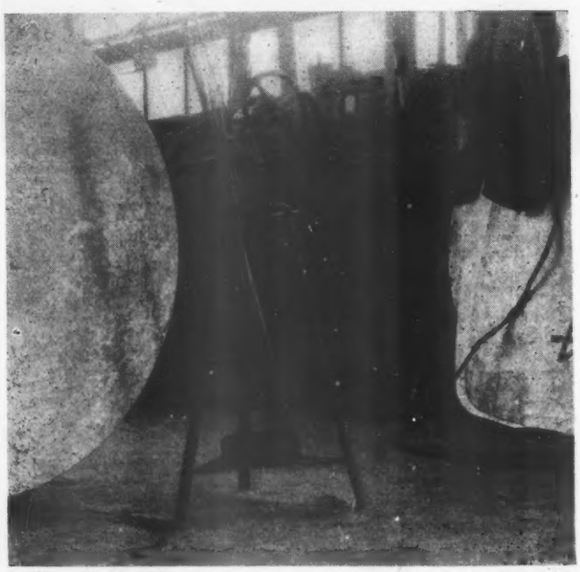
USING a jack to close car hopper doors is one of the hard jobs of the car repairman because it is often difficult to find a means of blocking the jack to prevent it from slipping. Ordinarily wood blocking has to be used, which often kicks out of place when pressure is applied. The device shown in the illustration is designed to eliminate this difficulty. It is made of bar stock about 3 in. wide and ¾ in. thick, one end of which is formed into a modified triangle, the base of which is 12 in. long and the vertical side 6 in. long. The base of the jack is placed against the 6-in. flat surface. The opposite end of the bar is bent at right angles, which forms a hook 5 in. long. This hook fastens over the rail. Since the device is 5 ft. 6 in. long, ample space is provided for placing in it any size of jack common to car repair work. With the device in position, as shown in the illustration, it is impossible for it to slip.



Method of using device when jacking closed car hopper doors

Handy Accessory for the Welder

WELDING must be done at widely separated points; the repair shops and the speed of operation depends more or less on the lightness of the welder's apparatus and its efficiency. The equipment should include a carrier for welding rods in which they are easy to reach. Such a stand, which is shown in the illustration, is made of three light pieces of angle iron joined at the bottom by a triangular sheet of light metal and at the top by three or four rings of metal, all welded



A convenient stand for the welder

together. An 8-in. metal collar is welded to the triangular plate at the bottom in which the lower ends of the rods are placed. The top ends of the rods are held by the rings, each ring being used for a different size of rod. A hook near the top of the stand is used to hang the welding torch on when it is not in use. Small boxes may also be added to the triangle at the bottom for holding small rivets, welding flux, etc.

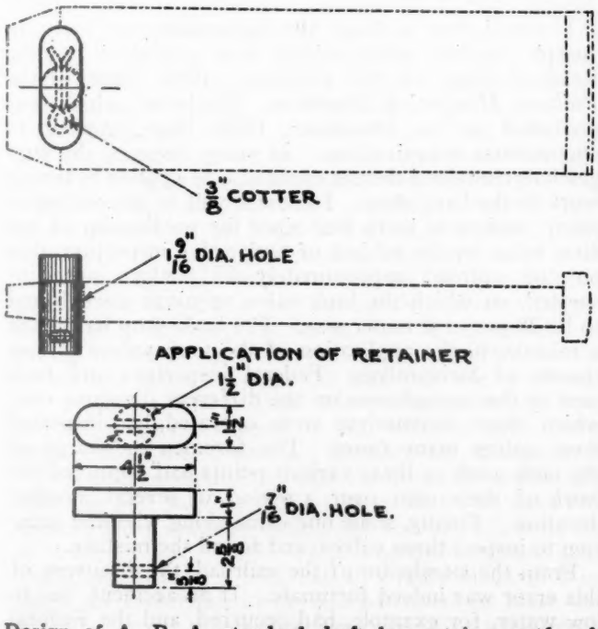
Draft Key Retainer Adopted by the A.R.A.

ACCORDING to Circular No. D.V.-649 issued on June 15, 1929, from the office of the Secretary of the American Railway Association, a special letter ballot was issued May 5, 1929, on the adoption as standard of the draft key retainer recommended by the Committee on Couplers and Draft Gears, and shown in the illustration. The result of the letter ballot on recommendation made by the committee in 1926 was issued November 22, 1926, in Circular D.V.-489, the standard to be effective March 1, 1927.

United States patent No. 1,645,817 was issued to Karl F. Nystrom, covering this device, under date of October 18, 1927. The American Railway Association, acting under the approval of the Board of Directors, has acquired the rights to this patent. All railroads in the United States, Canada and Mexico having lines running into the United States, car owners operating in the United States and car manufacturing companies may use the construction covered by this patent, free from any royalty or payment of any kind.

Section (d) of Interchange Rule 3 provides that this draft key retainer or approved equivalent is required on all cars built new or rebuilt on or after March 1, 1929, in order to be accepted from car owners in interchange. The Arbitration Committee and the Committee on Couplers and Draft Gears urge that this or an approved equivalent device also be applied to all cars in repairs, as it is felt that the cotter pin now commonly used is not satisfactory. Devices which it is desired to use as equivalent to the A.R.A. draft key retainer should be submitted to the Committee on Couplers and Draft Gears for approval by the car owner desiring to make use of one.

The draft key retainer illustrated will be included in the Manual of Standard and Recommended Practice as a standard of the Association in the next set of revised pages issued.



Design of A. R. A. standard draft key retainer made of dropped forged steel

Heavy Cart for the Blacksmith

MOVING heavy pieces of hot metal about the blacksmith shop, after they have been drawn from the furnace, is sometimes a problem, as usually the overhead hoisting facilities do not reach all parts of the shop. The wagon, shown in the illustration, was designed by a blacksmith foreman to solve this problem.

The top of the wagon consists of a row of parallel metal rollers mounted in a strong frame. The wagon is mounted on a pair of wheels which reach just high enough so that the metal may be drawn from the furnace door directly on to the cart. A long handle with a cross-bar forged at the end is used to draw the cart. A metal leg welded on the front of the handle supports the wagon with the top approximately level.

Two-wheel cart for moving heavy hot material in the blacksmith shop

ARC WELDING EQUIPMENT.—The application, distinctive features and general principles of construction of different types of stationary and portable multiple operator arc welding sets are discussed in Leaflet 20421, entitled "Multiple Operator Arc Welding Equipment," issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Long Hours Are a Handicap to the Foreman

WASHINGTON, D. C.

TO THE EDITOR:

Your recent editorial entitled "Is There a Future with the Railroads?" is timely, to the point, encouraging and stimulating. Few would want to return to the "good old days" even though all realize that fewer men are required to maintain the heavier power, operating longer distances, in vastly more efficient plants. Every indication is that the mechanical department employee of the near future will be more secure in his job than ever before and better satisfied. There is, however, one angle to this question which is rarely discussed in print, although it is one of the major issues of conversation and thought; namely, the working conditions of the foremen.

Overloaded or mediocre foremen affect costs just as adversely as do obsolete tools or facilities. It appears that too often everything has been improved except the house and conditions of the foremen. On many, if not most, roads the foreman works ten to twelve hours a day, with one day off every other week. When to this is added the time consumed in getting to and from work, eating and changing clothes, it is apparent that he has little time left for recreation and rest. As you say, "railroading has never offered men soft jobs" and it probably never will. The man adapted to railroad work is not the kind who wants a soft job, but he is human and should have some time to enjoy the good things of life. Are the railroad executives really convinced that all work and no play makes a dull man? Were it not for the fascination of the game, undoubtedly the overworked foreman would have retarded the wonderful progress that has been made. It appears that one of the virgin fields of endeavor is improving the status and thereby the calibre of the supervisory forces. One has to start out with and maintain a pace that will enable him to stick out the ten- or twelve-hour shift and, even if "pep" is displayed for a time, it cannot last long, as human endurance is limited, especially, unless there is a complete change of environment.

All long-hour foremen have to waste some of their time and it would be better for them to use this time for their own pleasure or benefit and actually produce all the time they are on the job. They have to *depend* on certain workmen to function properly, resulting in much lack of real supervision. Proper supervision does the planning and thinking, improves methods, instills enthusiasm and builds up morale.

If the supervisors below assistant master mechanics were on an eight- or nine-hour basis, would they not be in a much better position to fulfill these requirements, improve their minds by reading and study, love their work more, and be more of an asset to their company? From another viewpoint, the present over-worked foremen are somewhat of a permanent exhibit tending to show that without an organization it is practically impossible to secure consideration and proper working conditions.

Many officers no doubt think they are saving money by having two supervisors cover the twenty-four hours, but are they? To put all foremen on a nine-hour basis, with half an hour overlap at each end of their trick, will mean an increase of one half in the cost of such supervision. This sounds like lots of added expense. However, generally speaking, the cost of such supervision will amount to ten per cent or less of the payroll so that this increase of fifty per cent really means only five per cent of the total, and certainly the closer supervision, aside from all the other advantages, should be able to save more than this amount through reduced labor and material costs.

While there will always be need for special duty men and special inspectors, some of these could probably be eliminated to help pay the new foreman, because often the lack of suitable supervision requires additional checks. Better working conditions will attract and hold, as well as satisfy, better men and these jobs will be in great demand.

JOHN MITCHELL.

Further Comment on Tank-Valve Inspection

BELLEFONTAINE, OHIO.

TO THE EDITOR:

I would like to have the opportunity to reply to Joseph Smith's letter which was published on the Readers' Page of the February, 1929, issue of the *Railway Mechanical Engineer*. My letter, which was published in the December, 1928, issue, applied to enginehouse organizations. In many respects, the suggestions contained therein could also be applied to tender work in the back shop. I know it will be interesting to many readers to learn that since the publication of my first letter on the subject of tank valve inspection, that on one railroad approximately 65 tenders were inspected, on which the tank valve openings were found to be 28 per cent under size. The back shop had made a mistake in the application of the tank valves to two classes of locomotives. Federal inspectors and tank men in the enginehouse on the different divisions over which these locomotives were operated, had inspected these valves many times. The foremen in charge of the tank work at these various points had approved the work of their men over a period of several months' duration. Finally, some one came along who had occasion to inspect these valves, and found the mistake.

From the standpoint of the railroad, the discovery of this error was indeed fortunate. If an accident, due to low water, for example, had occurred, and the Federal inspectors investigating the accident had found the un-

dersized valves to be a contributing factor, who would have had to do the explaining?

Frankly, I do not believe that there is a single job on which the foreman can not find time occasionally to check up the details of the work, not only with the object of seeing that the work is being properly done, but also to see if there is not room for improvement. A foreman draws a higher salary than the men under him because the position he holds is one of greater responsibility. He should not pass responsibilities which rightfully belong to him on to some one else. This seems to me, in the final analysis, to be the real difference of opinion between Mr. Smith and myself.

A. T. E.

Is Rule 66 Accomplishing Its Intended Purpose?

New Haven, Conn.

To the Editor:

An editorial entitled "A Trend in the Right Direction," which appeared on page 229 of the May issue of the *Railway Mechanical Engineer,* may indicate a trend in the right direction, but it is a long way from its goal. I wish to call attention to the fact that this rule had the same provisions some eight years ago as it has now. The rule did not work out satisfactorily then, although its potentialities were great. Prior to 1922, it was permissible to jack and pack boxes on foreign cars if the date was more than nine months old. It is my contention that the same provisions should be included in the present rule.

If a car cannot be shopped for box packing alone, it will be possible for some cars to go two or three years without attention being given to the boxes. The rule states that cars must be on a repair track for repairs before this work can be done. It also stipulates that the billing repair card must state what the car was shopped for. Under the circumstances, a car may be on the repair track because of no bill or a hold card without the boxes receiving attention, although the box packing date may be overdue for 12 or 18 months. Such cars cannot be jacked and packed, provided, of course, you wish to get paid for the work. This may sound absurd but, nevertheless, it is the only interpretation that can be placed on this part of the rule.

Why does not the A.R.A. set some time limit for this work the same as it does in regard to Rules 30 and 60? Under the present rule a car may not receive periodical inspection for two or three years if fortunate enough to be kept off the repair track. One might say this is impossible since the air brakes must be cleaned at least once a year; but do not discount the fact that not a few roads clean air brakes at freight houses and in transportation yards. What recourse is the car owner going to have if inspection after the car is received home develops the fact that the work was not properly done? Past arbitration decisions have ruled that joint evidence is not valid in such cases, stating that Rule 12 was not intended for this purpose.

It is not uncommon to find cut journals under cars with the box packing dates within 30 to 90 days old. A good many roads are using one size of back rolls for all different size boxes. It is impossible under such conditions to keep a back roll to within ½ in. to 1 in. below the center line of the journal when the same size of roll is used for a 7-in. journal as is used for a 12-in. journal. The A.R.A. standard practice states that the main body of the packing should be 1 in. below the center line of the journal. It is my contention that the main body packing should be not more than ½ in. below the center line of the journal. This was formerly the A.R.A. recommended practice.

I was recently told by a supervisor of one of the largest railroads of the country that they did not pack boxes on their own equipment in accordance with A.R.A. rules, but did follow the rule when packing a box on a foreign car. Some time ago I heard a car department supervisor remark that the back rolls were not being applied right. He then explained how his men did this work; the method was not in accordance with A.R.A. rules. It was not that this man was ignorant of the rules; on the contrary, this man was an expert on the subject.

From careful observation of cars with current box packing dates, I have found that a great many roads are not packing their boxes in accordance with the A.R.A. rule. If every Tom, Dick and Harry is going to inject his own idea into this rule, there is going to be plenty of trouble. If everyone lives up to the rule, faulty conditions will be brought out with more speed and these conditions can be corrected more readily.

The present rule states with reference to dust guards that they may be changed only when the wheels or boxes are removed. A box may be packed 100 per cent perfect, but it will not stay in that condition long if the dust guard is broken or badly worn. The oil will work out and let in plenty of dirt. At this time I wish to bring out the fact that the rule has made no provision for dust guard caps or plugs. A good many roads are applying these caps, and it is to a great advantage, especially on open-top cars when loaded with sand or fine-cut rock. A close inspection of a dust guard well after the application of the dust guard will disclose the fact that there is a space of from ¼ in to 1 in. from the top of the dust guard to the top of the well.

It would do well to investigate waste grabs and find out what actually causes them, especially when found on the outside or the opposite side of the brake shoe. If a careful inspection is given to the journal when new wheels are applied, knicks may be found which cause many of the waste grabs. Small rough digs caused by loading and unloading wheels are very dangerous if not removed before the wheels are applied. These rough spots pick up the waste and drag it under the bearing, thereby choking off the lubricant. I have found a good many waste grabs that could be attributed to the springs in the waste, but I think that springs do far more good than harm, notwithstanding the fact that very few roads are using this kind of waste.

Rule 66 has been a live question for the past three years. It was slated to go in effect January 1, 1927. It was postponed to May 1 of the same year, extended again to January 1, 1929, and again extended to March 1 of this year, and it is now extended to January 1, 1930. Five times this rule has been extended and it would not surprise me to see it extended the sixth time. Various reasons have been given for extending the effective date of this rule; first, to give the car owner a chance to get all of its cars jacked and packed up to date; second, the lubrication committee wished to revise the A.R.A. recommended practice and to make it an A.R.A. standard. Enough time has been granted to take care of the issues mentioned and it should not be necessary to extend the effective date of this rule again.

James W. McDonnell

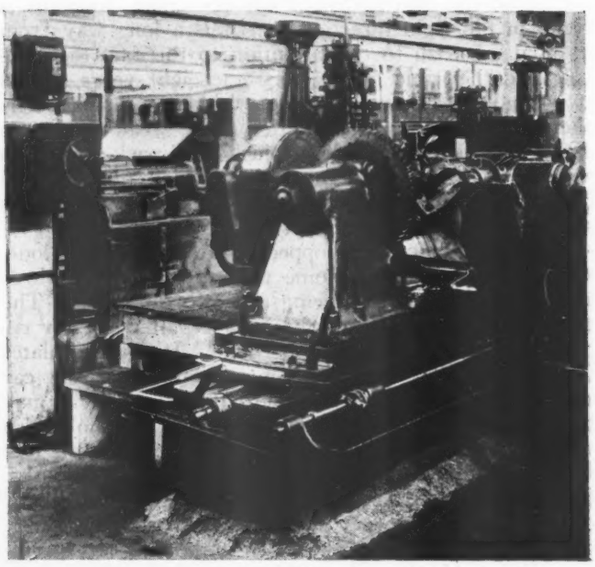
Southwark Slot Cottering Machine

THE Southwark Foundry & Machine Company, Philadelphia, Pa., builders of hydraulic and power machinery, have placed on the market a powerful slot cottering machine, especially designed for cutting the key slots in large locomotive piston rods and crossheads.

The machine has a capacity of cutting out through slots of 2 in. in width for a length of 36 in., this length being given for general purpose work and not especially required for locomotive parts. The maximum diameter through which a slot may be cut is 15 in., this large diameter being called for by some of the collars on crossheads.

The key slots referred to are often cut out by the two machine process of drilling and slotting. This method often leads to inaccuracy in the position of the slots as all depends upon the skill of the workmen. This hazard is eliminated with the new cottering machine as its construction assures the centralization of the slots without measurement or particular care.

This machine will cut slots 2 in. in width for a length of 36 in.



Operators position of the Southwark slot cutting machine

The machine consists of a main bed forming the slide for the work table which travels to and fro an amount proper for the length of slot wanted and carries the fixtures for holding the work piece in position.

At either side of the main bed are transverse beds or slides for the two opposed spindle heads which have a cross adjustment toward and away, one to the other for accommodating the size of the work piece, and an inward automatic feed toward the center of the machine for working out the metal as the table travels.

An adjustable automatic stop is provided for reversing the speed of one spindle head to prevent the drill points from coming together while cutting through the slots.

The spindles are of large diameter, revolving in ball bearings at from 150 to 600 r.p.m., and are driven by a direct connected adjustable speed motor with all gearing encased.

For supporting the work fixtures, the table is fitted with a swivel member so that piston rods may be set at an angle for obtaining the taper ends of slots as generally required. On top of, and clamped to, the swivel member of the table are a dead center head and a centralizing vise for holding the piston rods. Substituted for the vise is a swivel shelf which in conjunction with the dead center head is used for supporting the crossheads. The swivel shelf is indexed for degrees and positioned by crank handles and gearing.

The machine is equipped with a pump for directing streams of cutting fluid on the tools and a complete drainage system for the return of the fluid to a reservoir furnished as part of the machine.

The operation of the machine, after cutting has been started, is entirely automatic and two or more machines can be operated to advantage by one workman.

While this machine was developed primarily for cutting the key slots in locomotive piston rods and crossheads, it can be used to the same advantage cutting the round end keyways in large shafts, whether single keys or double opposed keys and whether the shaft is long or short. For long shafts two vises are provided for the table so that the shaft may be shifted lengthwise and the keyway cut in any position of its length.

Slot cottering machines heretofore have been of rather light construction, the most expected of them being the removal of metal in the form of fine metallic dust instead of chips of appreciable size. In the development of the new cottering machine the Southwark Company had in mind the need of a tool that would do real work and with this design have been successful in meeting their objective.

Dual Motored TexDrive Buffer

THE Hisey-Wolf Machine Company, Cincinnati, Ohio, has placed on the market a dual motored TexDrive buffer which has two separate and distinct spindles, each operated by its own motor. Either spindle may be operated independent of the other. Each motor has its own starter and can be started or stopped at will. This arrangement makes it possible to have the two spindles operating at different speeds at the same time.

The machine is of gooseneck design which gives the operator greater freedom of movement and permits easy handling of large and bulky pieces. Accessibility of all parts and rigidity of construction are incorporated in a way that is unusual. The base consists of a substantial casting, inside of which is mounted the motor, starter and starting switch.

The spindle and bearing housing of the buffer are assembled as a unit which may be quickly removed from the base by loosening four bolts on each side. This arrangement simplifies the problem of removing a worn or broken belt and replacing it with a new one.

The motor is secured to the sub-base at all four corners by bolts placed in grooves. This arrangement not only gives solid four-point mounting, but also permits easy adjustment of the motor forward or backward to secure proper belt tension. When adjusted to the right location the motor is held securely in position by tightening the nuts on the four bolts.

Changing the belt on the TexDrive is very simple. With ordinary buffer construction, it is necessary to almost entirely dismantle the buffer in order to change the belt. The Hisey unit head eliminates the necessity of removing the spindle from the bearing housing when changing a belt.

A change of belts is made as follows:

(1) Loosen the bolts of the motor frame and slide the motor forward on the ways so that belt will be in a lax position.

(2) Slip the belt from the motor pulley.

(3) Loosen the four bolts on each side of the spindle housing.

(4) Lift the entire spindle assembly and slide the belt over either end without removing the spindle from the housings.

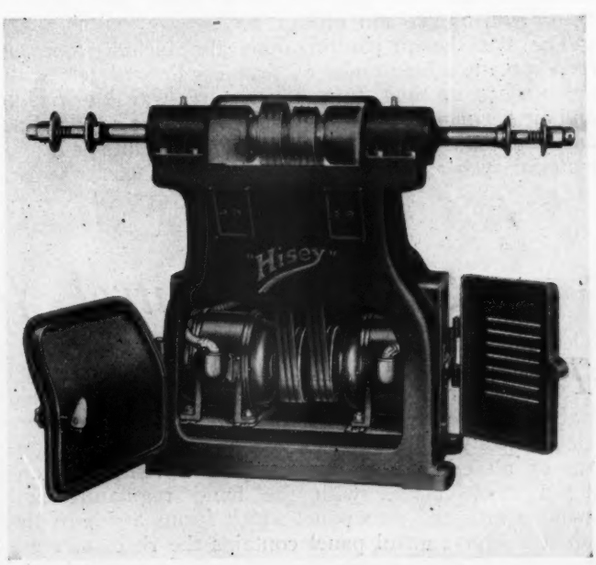
To replace a belt just reverse the foregoing operations.

The unusually wide range of motor adjustment makes it possible within practical limits to secure a different spindle speed by merely changing the motor pulley—using the same drive.

The motor starter is mounted on the inside of one of the end doors, making it instantly accessible by merely opening the door. Louvers in the end doors keep out dust and permit circulation of air. The starter is automatic, providing protection from low voltage, phase failure and overload. The starter button is mounted in a convenient position in the top front of the column.

The spindle bearing boxes are cast iron and are keyed to the column. A key along the entire base of the bearing housing fits into a keyway in top of the column. Thus no matter how often the bearing housing is taken off the keyway arrangement insures perfect re-alinement of the spindle and motor pulleys.

Automatic lubrication is obtained by a simplified oiling system. Oil chambers in the bearing housing



Hisey dual motored TexDrive buffer with independent spindle control

are filled through conveniently located cups. Gages at the back of each bearing housing insures that excess oil will escape through an overflow vent, at the same time automatically indicating the oil level. A flushing plug at the bottom of the gage permits quick flushing of the bearings.

The one piece spindle is of extra large diameter and made of nickel steel accurately machined to exact diameter to insure perfect balance. The spindle ends are provided with flat top threads which afford greatest security in holding the buffing wheels in place. They retain their shape and insure safety throughout the long life of the machine. The buffing wheel is held securely by a safety nut made of Tobin bronze, extending to the extreme end of the spindle, thus affording complete protection to the threads.

The wheel flanges are flatted on two sides permitting easy gripping with a wrench. The inside washer is keyed to the shaft. Dust covers on each end of the bearing housings are provided with labyrinth seals which prevent dust and dirt from getting into the bearings.

The spindle pulley is provided with a removable dust proof hood made of cast iron, making the pulley and belt instantly accessible by lifting off the hood.

The TexDrive buffer is made in two styles—with a single motor drive and with dual motor drive. Both open and encased type spindle extensions are provided.

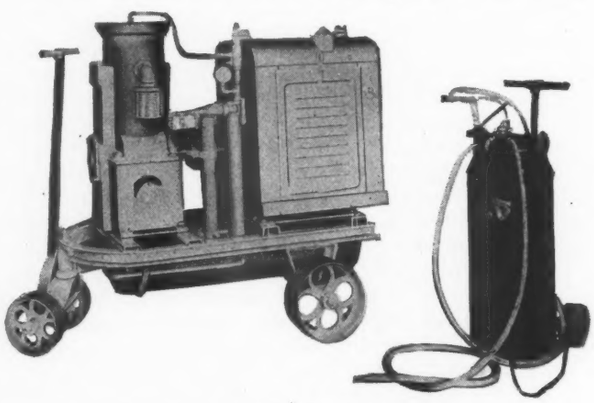
Portable Spray-Painting Unit

A PORTABLE, gasoline engine-driven, air-painting unit, recently placed on the market by the Paasche Airbrush Company, 1909 Diversey Parkway, Chicago, is being introduced in railroad service for general maintenance painting of all kinds. It is said that with this equipment the average box car and trucks can be air painted in two hours as compared to 10 hours by hand brush methods and a box car alone, less trucks, can be airpainted in 30 minutes or less. Five buildings were painted in 8 hours which formerly required 24 hours with two hand-brush operators to do the same work.

The Paasche air-painting unit comprises a Worthington hopper-cooled, feather-valve air compressor, designed for high efficiency and low maintenance, driven by a Novo 6-hp., 2-cyl., gasoline engine, directly connected. This engine is radiator cooled and provided with magneto ignition, roller bearings and force-feed lubrication. Both the air compressor and engine are mounted on a reinforced channel chassis provided with four wide-flange wheels to permit ready portability of the unit over soft ground, if necessary. An air tank or reservoir, 9 in. by 44 in., is supported beneath the chassis. Other equipment on the chassis includes a clean air intake filter, automatic unloader and patented 32-ft. water and oil separator with gages and fittings.

The Paasche air-painting unit also includes one or more pressure feed tanks of seamless drawn steel with patented clamp-tight, 9-in. cover, three-way inlet valve and air regulator. The line pressure can be adjusted to any required amount to atomize ordinary paints or heavy material such as cement wash, asphaltum, etc.

The air gun is made of strong, light material, being



Paasche air-painting unit driven by Novo, a 6-hp. gasoline engine

of standard construction with all parts and threads fully enclosed and interchangeable. The material inlet swivel may be connected from the top or bottom of the air gun to facilitate easy handling under all working conditions. The two-finger trigger and a taper stainless-steel needle control the flow of paint, eliminating waste. This needle seals the fluid feed opening air-tight so that the paint or material that does not settle quickly may be left in the hose without clogging. The Paasche air-painting equipment can also be used for light sand blasting.

Unified Control for Lincoln Welders

THE unification of the controls of both motor and generator is one of the features of the redesigned Stable-Arc welders manufactured by the Lincoln Electric Company, Cleveland, Ohio. The working mechanism of all controls is contained in a ventilated, enclosed steel cabinet with the hand regulators and switches mounted on a panel which forms a side of the cabinet. The control panel contains the rheostat regulator, the diverter switch, the safety starter switch, the voltammeter and the wing nut terminals for the cables. This unified control greatly increases the simplicity of the operation of the welder. The control cabinet is mounted directly over the motor generator for easy access by the welding operator. This also permits the removal of the motor-generator armature, without disturbing any other parts.

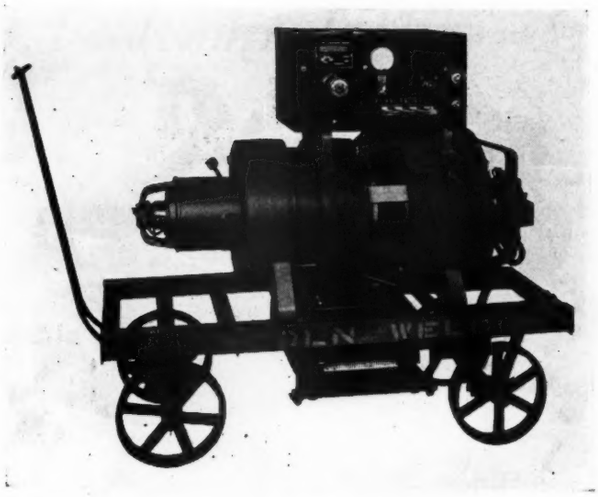
The use of voltammeter, makes possible the reading of the amount of voltage and amperage on one dial and eliminates the use of a separate ammeter which would be given excessive wear on a Lincoln welder, because of the large output keeping the ammeter jammed against the high limit pin on the dial. In this

way the voltammeter insures longer instrument life. The face of the voltammeter is mounted flush with the control panel, assuring the utmost protection possible.

Terminals for the lead cables are equipped with winged nuts, a feature which makes quick and easy connections possible, especially when it is desired to reverse the polarity of welding current. The use of these wing nut terminals also eliminates the necessity of a switch for reversing polarity.

The Lincoln safety push button switch is incorporated in the control panel for starting and stopping the welder. This type of switch, manufactured by the Lincoln Electric Company and introduced to the market only a short time ago, offers an added safety feature to the control mechanism of the new model welder. With this type of safety switch it is impossible to accidentally start the welder.

Enclosed wiring of all operating controls as well as a metal backed rheostat are the result of the use of a unified control cabinet. The mounting of this cabinet over the motor generator permits the use of a shorter chassis frame or base than used in previous models.

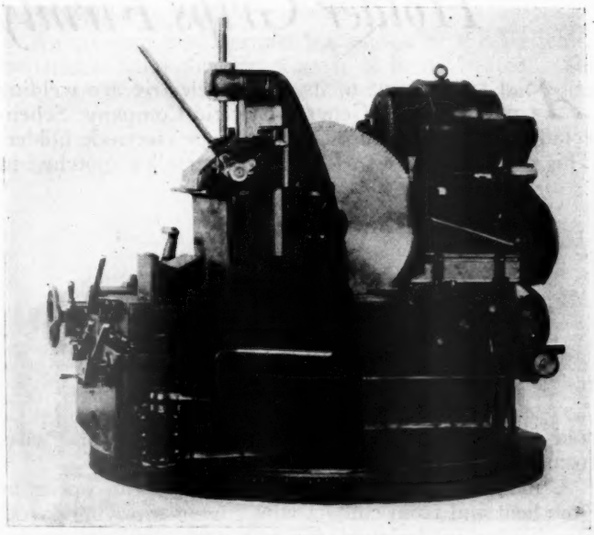


Lincoln 300 ampere portable welder of a new type for alternating current power supply

Heller Heavy-Duty Cold Metal Saws

SEVEN sizes of metal cutting-off machines, ranging from 1¾ in. diameter to 20 in. diameter capacity, are offered by the Steinle Turret Machine Company, Madison, Wis., in the Heller high-efficiency cold metal saw. This is a heavy-duty machine tool, rigidly proportioned, all-steel geared ball bearing equipped, long saw arbor carriage slide bearing, with the final saw arbor drive through the medium of a worm gear unit with the driven worm one-half the diameter of the blade itself and a two-to-one herringbone gear unit which gives a smooth, powerful drive. The blade cuts the stock on the upward motion and thus places the stress and strain of the cut down against the bed of the machine where it is easily absorbed to prevent vibration and chatter instead of up against a weaker bearing cap or housing.

Four blade speeds and five blade feeds are available through selective gearing, thus giving a flexibility of operation for the hardest as well as the softer materials. Control of the machine feeds is from the operator's position at the front of the machine. Feeds can be changed while the blade is under cut. An elastic clutch sets as a safeguard against excessive pressure and thus prevents any damage to the saw blade or machine should the carriage be run up against the work through carelessness of the operator. Adjustable feed trips are provided and, at the completion of the cut, the blade carriage automatically returns to the starting position by quick power traverse.



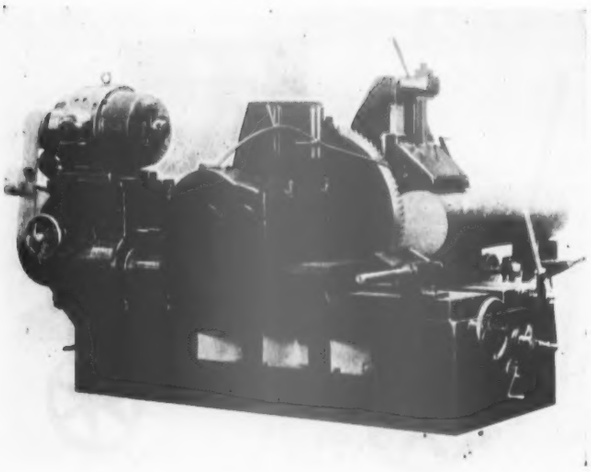
Type SSQ used for straight and miter cutting on sectional work

The stock is fed to the stock stop mechanically by a roller arrangement which is brought into contact with the bar by a slight pressure on the control lever. This moves the stock to position accurately and relieves all strain or bar stock control from the operator. The free end of the bar is carried upon a roller bar carrier traveling upon a narrow gage track at right angles to the machine. Clamping of the stock is made easy by the "hammer type" clamping wheel, which eliminates the necessity of the hard straight pull on the stock clamp to get it sufficiently tight for cutting.

The drive is through a single pulley direct to the change gear box. The gears all run in oil and the shafts run on ball bearings. A special type blade chip remover eliminates the chips that adhere to the blade teeth after passing through the cut. A deep sump for the coolant compound is built integral with the machine base and furnishes through a separate pump a heavy flow of coolant to the point of the blade throught a double oil pipe lead.

For motor drive, the motor is placed upon the top of the gear box and the drive is through a belt with an idler pulley arrangement to secure proper adjustment, thus making a very compact, self-contained unit.

The blades furnished with the machine are of the orginal Heller segmental type, composed of a center disc of heat-treated, high tensile steel, to the periphery of which a set of high-speed steel segments is riveted. These segments are milled or slotted to fit directly over



Heller heavy-duty type SS cold metal saw

the shouldered edge of the disc so as to insure proper alinement under the severest of cuts. Each segment comprises four cutting teeth, the alternate teeth being of the beveled roughing type or square finishing type so that the chip is split into three parts to relieve the strain at the point of the cut.

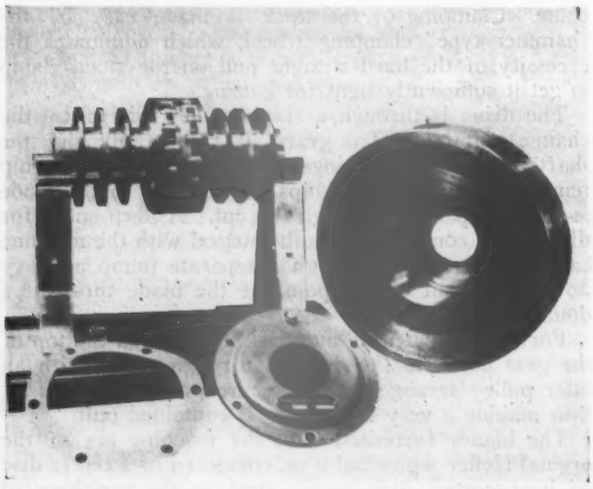
These machines are also built in special types with a rotary base and cross feeding table for angular cutting and in types for crank shaft work, rail cutting and foundry sprue cutting.

Grinders of the fully automatic type for sharpening the blades are furnished in three sizes to accommodate the range of blades.

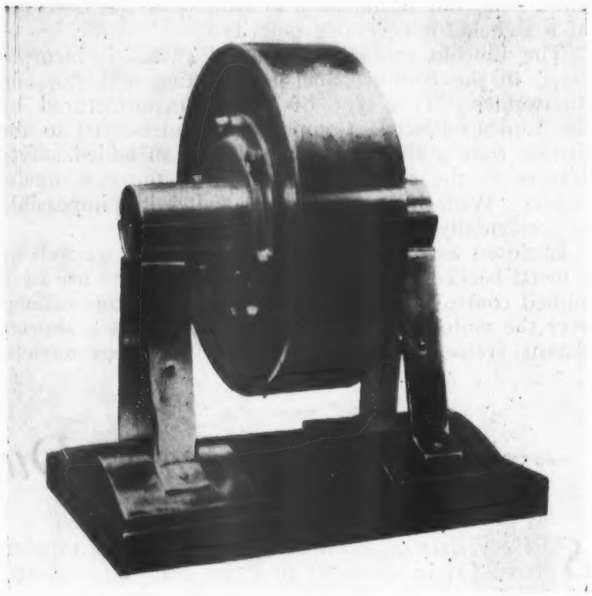
Roller Bearings for Turntable Equipment

THE turntables at small engine terminals are often operated by motor cars, the weight of which are not distributed equally, which makes the small balanced type table with brass journals rather difficult to turn. The illustration shows a type of roller bearing developed for a large eastern road by the Stearns-Stafford Roller Bearing Company, Lawton, Mass., to eliminate the journal friction so that the small tables can be handled by man power in place of motor cars.

The wheel is furnished in two different materials:



Disassembled view of the thrust bearing type of roller bearing unit for use on a turntable



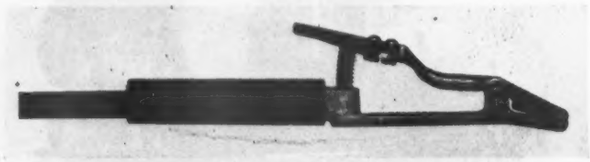
The unit as it appears when completely assembled

An alloy steel forging, heat treated, or of manganese steel. The construction of the unit is clearly indicated in one of the illustrations.

It does not require any changes to make the application, as the axle conforms with the axle in use so that the location would be identically the same.

Welding Electrode Holder Grips Firmly

AS a supplement to its line of electric arc welding equipment, the General Electric Company, Schenectady, N. Y., announces a clamp type electrode holder. This device has jaws of heavy copper alloy, notched to hold firmly in any position any size of electrode wire from 1/16 in. to ¼ in. in diameter.



Metallic holder for electrodes up to ¼ in. thick

A molded compound handle protects the operator from heat and from contact with current-carrying parts. The holder is designed for use with currents up to 300 amperes. It may be obtained, if desired, assembled with 5 ft. of extra-flexible cable and a terminal.

Worthington Type S Feedwater Heater

THE Worthington Pump & Machinery Corporation, Harrison, N. J., has placed on the market a new type of feedwater heater which differs from the unit construction of the Standard BL type in that it is designed in three units; namely, a hot-water pump, a cold-water pump and steam turbine, and the feedwater heater unit. The Type S offers advantages in total weight reduction and weight distribution.

The cold-water pump, mounted under the left side of the cab, takes water from the tender and delivers it to the heater which is set into the top of the smoke box. Here the water is heated by mixing with exhaust steam from the locomotive cylinders. From the heater, the hot water flows down to the hot-water pump, mounted on the side of the boiler. The hot-water pump forces the heated water into the boiler through the boiler check.

The cold-water pump is a standard Worthington centrifugal pump driven by a low-speed Pyle-National steam turbine. The turbine is equipped with the regular Pyle-National governor, identical with that used on generator sets for train lighting and automatic train control, and runs at a constant speed.

The cold water is delivered to the heater through a float-operated water-control valve, and a spring-loaded spray valve. The amount of water passing through the water-control valve depends on the level of the water in the heater. When the water level is low and the float is down, the valve is open and admitting cold water to the heater. As the water level rises the float rises, gradually closing the water-control valve. If the water level is then lowered, the float descends and opens the valve again. Thus the water-control valve will always be open just a sufficient amount to supply the hot-water pump for the speed at which it is operating.

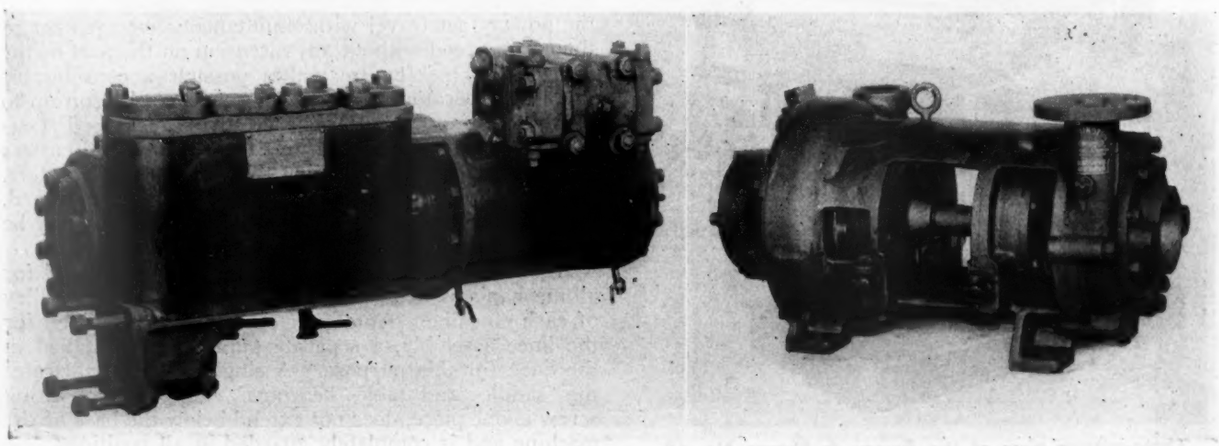
Exhaust steam from the locomotive, entering the heater, passes upward through an exhaust check valve of multiple self-grinding cup type which is a part of the heater. The individual valves have spherical seating surfaces, so as to seat in any down position. Their movement is free and the spherical seating surfaces insure against leakage.

An air-vent pipe permits the escape of the air which separates from the water as it is being heated. The open lower end of this pipe should be in a convenient position near the track where it will be visible when the pumps are tested.

The heater unit of the Worthington Type S feedwater heater

The hot-water pump is a single horizontal long-stroke piston pump, having enclosed valve gear. As the speed of the cold-water pump is constant, and the water level in the heater is automatically controlled by the float, the rate of feeding the boiler depends entirely upon the speed at which the hot-water pump is operated. This is controlled by a throttle valve in the cab.

The drifting control valve is placed in the exhaust pipe of the hot-water pump. It is a device which prevents the pump from being run fast while the engine is standing or drifting. It relieves the engineman of the necessity of closing the feed-pump throttle valve when making a stop or of shutting it off for drifting. The engineman need pay no attention to the feed pump until the stop has been made, and he is ready to shut it off. The pump will automatically slow down when the locomotive throttle is closed and will automatically speed up again when the locomotive throttle is opened. This



Left—The hot-water pump; Right—The cold-water pump and the steam turbine

valve is controlled by live-steam pressure from one of the side pipes, led to the valve by a ⅜-in. pipe.

The drifting control valve is adjusted at the factory to open when the locomotive steam-pipe pressure reaches 50 lb. and to close when the pressure is reduced to slightly below 50 lb. It requires no attention other than to see that the spring is so adjusted that the valve opens when the steam-chest pressure is slightly above locomotive drifting-throttle pressure. When the valve is open, exhaust steam from the steam cylinder of the hot-water pump passes freely through it, unrestricted, to the heater. When the valve is closed the exhaust from the hot-water pump must pass through a small orifice inside of the valve body.

The drifting control valve is adjusted by removing a cap nut and turning an adjusting screw. Turning the screw to the right makes the valve open and close at higher pressure. Turning the screw to the left makes it open and close at a lower pressure.

The gage in the cab is connected to the discharge pipe of the feed pump and indicates by a movement of its hand whether the hot-water pump is running and how fast. Each forward motion of the hand indicates one stroke of the pump. A three-way self-cleaning cock, having a 1/64-in. choke is furnished with the gage. In the operating position the water has to pass through this choke, which reduces the throw of the hand to an amount that will not injure the gage. In the cleaning position the choke is open to the atmosphere and the pressure of the water forces out any obstruction and clears it.

The cleaning port should always be directed toward the boiler head so that any discharge will be directed away from the occupants of the cab.

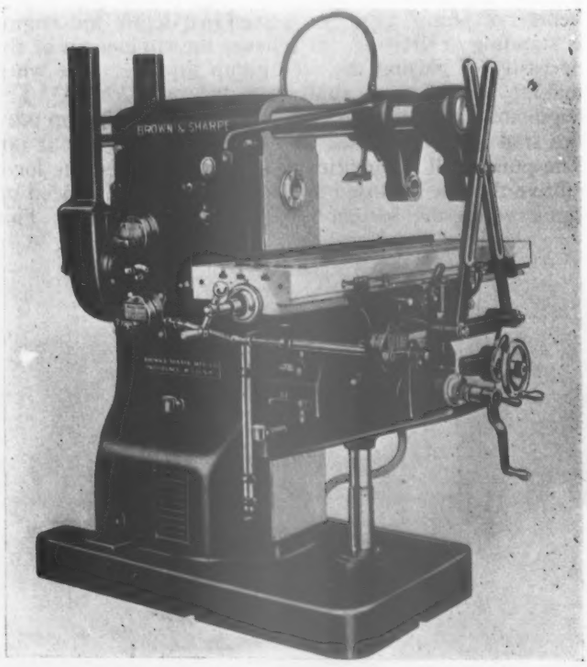
Two steam strainers are furnished with each equipment. One is located in the live-steam pipe of the cold-water pump and one in the live-steam pipe of the hot-water pump. These strainers remove all chips and other foreign matter in the live steam and prevent them from entering either the steam turbine or the cylinder of the hot-water pump. These steam strainers should be blown out every few days, by opening the clean-out valves on them while the pumps are running.

A safety valve is furnished in the exhaust pipe of the hot-water pump between the drifting control valve and the heater to relieve any excess pressure in the heater. This valve is set at 45 lb. and sealed, and its outlet is piped down to a point near the track.

The pump throttle valve is of the cone seated type with a Monel metal disc and seat. The starting valve is a full area globe valve, with a Monel metal disc and seat.

Additions to Brown & Sharpe Milling Machines

THE Brown & Sharpe Manufacturing Company, Providence, R. I., has recently announced the addition to its line of Standard milling machines of the Nos. 4A Standard universal and 4B Standard plain milling machines which are the largest of the Standard line of milling machines. They include the construction and operating features of the Standard machines and are designed to accomplish the heavier types of milling with economy.



Three-quarter view of the Brown & Sharpe No. 4B Standard plain milling machines

The machines are all gear-driven with anti-friction bearings from the driving pulley to the spindle and also in the feed and power fast travel mechanisms. Two operating positions are provided on each machine (one at the front and one at the rear of the table) with all levers controlling the operation of the machine readily available from either position. Dual control for feed changes (a lever at the front of the table and one at the rear) facilitates feed changes. Speed changes in two series are made by a single lever at the side of the machine. The rates of feed and speed for which the machine is set are indicated by direct-reading dials located above the control levers. The machines are equipped with power fast travel for longitudinal, transverse and vertical movements, operated by handy levers.

One of the important features of the No. 4B Standard plain milling machine is the automatic disengagement of the power fast travel with simultaneous engagement of the cutting feed without any attention on the part of the operator. This feature makes possible a considerable saving in operator's time, as the work can be run up to a point close to the cutters before the cutting feed is engaged. It also prevents injury to the work and cutters through accidentally jamming the work into the cutters. The operator is free, after the fast travel is engaged, until the cut is completed, during which time he may be engaged in operating another machine.

Automatic lubrication with filtered oil is provided for all mechanisms within the column and the driving pulley of each machine. Automatic oiling is also provided for the knee assembly, a separate pump being installed in the knee for this purpose. A single oil well lubricates the saddle and table bearings. The knee-elevating screw is one piece, does not extend below the base of the machine and is completely guarded in all positions.

The machines are available either for belt drive, fitted

for a motor, or equipped with a motor. When motor-driven, the motor is located in a ventilated compartment in the base and drives the machine by chain and sprockets. The motor is mounted in such a manner as to be rigidly held in place, yet readily accessible. Adjustment of the tension in the driving chain is by an adjusting screw located outside the motor compartment. The entire drive is adequately guarded.

A Ventilator and Solid-Bottom Car Door

ALL southern roads at the present time are using two sets of doors on box cars, one set for ventilating cars when loaded with perishable goods and a second set of solid doors when the cars are loaded with general merchandise. To eliminate the necessity of using two sets of doors, M. F. Fitzpatrick, general foreman, car department, of the Seaboard Air Line, Jacksonville, Fla., has patents pending on a combination ventilator and solid-bottom car door.

The structure consists of two door stiles made of ⅛-in. by 5-in. by 7-ft. 4-in sheet steel. On the inner edge of each stile, next to the ends of the louvers, is a water channel in the form of a Z-bar. The back side of the door is made to fit inside of an angle iron which is applied to the car to form a weather strip. When the louvers are in a closed position, each one overlaps the other one inch throughout the door and the ends of each louver neatly fit into the door stile and lie on top of the water channel, which has an edge flanged outward to prevent the water from going inside of the car. Thus, any water that may escape over the ends of the louvers flows down the drain channel to tne bottom of the door.

The top mullion is made of ⅛-in. by 8-in. by 6-ft. 2-in. sheet steel, stiffened with an angle and made to fit all door hangers except Jones hangers. It also carries a support for the eccentric rod. The bottom mullion is made of ⅛-in. by 7¼-in. by 6-ft. 2-in. sheet metal, also stiffened with an angle and offset at the top to allow the bottom louvre to extend over it and make a water-tight joint. The bottom mullion also carries an eccentric-rod support.

An intermediate mullion, so called, is located between the third and fourth louvers from the bottom. It is offset at the top so that the fourth louver in the closed position will fit into it to form a water-tight joint. A piece of sheet steel, ⅛ in. by 3 in. by 6 ft. 2 in., is bolted

A door with the louvers open

across the intermediate mullion; it serves to brace the door stiles and also carries two sealing devices, the throw-lever bar, an eccentric-rod support and the hasp.

The eccentric rod is ⅞ in. in diameter, 6 ft. 8 in. long and has three offsets, one at each end and one which works on the hasp bar. This rod is attached to the louvers with U-hasps, and pins one on each louver. Each end of the rod is free to move in an eccentric support one fastened to the top and one to the bottom mullion. When the eccentric rod throw lever is moved horizontally from one side to the other, it causes the eccentric rod to open or close the louvers. The throw lever is fastened to the eccentric rod with lugs and a connecting pin which form an eccentric.

Seaboard car equipped with the combination ventilator and solid-bottom car doors—The louvers are in the closed position

The dimensions of the louvers are ⅛-in. by 6-in. by 5-ft. 4-in. sheet steel made in the form of a double offset or modified Z with pivots on the ends, about which they rotate. The door contains 15 louvers with openings 2 in. wide by 64 in. long between them, which provide an air space of 16 sq. ft. per door. Practically the entire door height is ventilated.

The application of these doors eliminates two doors with their fixtures from each car. By applying the doors to the car shown in the illustration, a total saving of $89 was effected and the weight of the car was reduced by 507 lb.

Rust-Prevention Treatment for Air Reservoirs

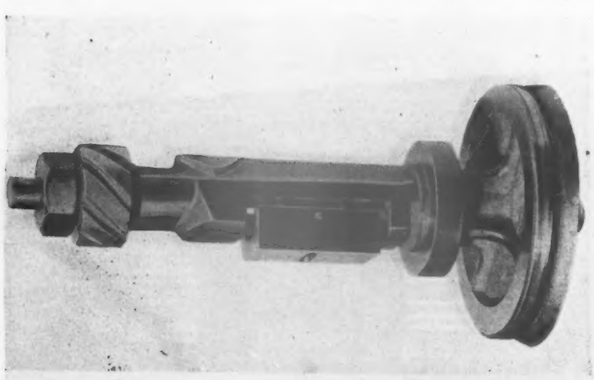
THE Westinghouse Air Brake Company, Wilmerding, Pa., has adopted the NO-OX-ID treatment for reservoirs used with passenger-car brake equipment. This is the rust preventive now used extensively to protect railway equipment parts, such as underframes, springs, crank pins, etc.

The NO-OX-ID compound is applied to the interior of the reservoir at high temperature by a process that covers the entire surface and leaves a thin semi-hard coating. This is so constituted as chemically to resist oxygen and physically resist any tendency to crack or scale.

To identify reservoirs so treated they are marked with a letter N on the head following the Westinghouse monogram.

Change Made to Distributing Valves

THE Westinghouse Air Brake Company, Wilmerding, Pa., is now supplying an improved type of application piston for distributing valves which are expected to reduce maintenance costs. The piston-

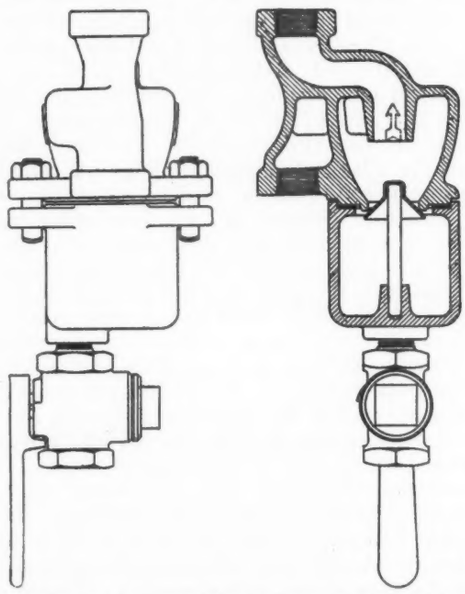


Westinghouse application piston for distributing valves

stem guide is of more ample proportions, which reduces wear to a minimum and insures correct alinement. The periphery of the guide has a set of helical grooves which tend to keep the bushing scraped free of dirt.

New Westinghouse Air Brake Devices

TO complete its line of centrifugal dirt collectors. the Westinghouse Air Brake Company, Wilmerding, Pa., has developed a design suitable for installation in a ½-in. pipe. It embodies improvements common to the design for horizontal installation; viz., the detachable large capacity dirt chamber and the



Westinghouse ½-in. centrifugal dirt collector with vertical pipe connections

check valve which isolates the dirt chamber from the brake system when a heavy reduction in pressure is made. It may be furnished with or without a drain cock.

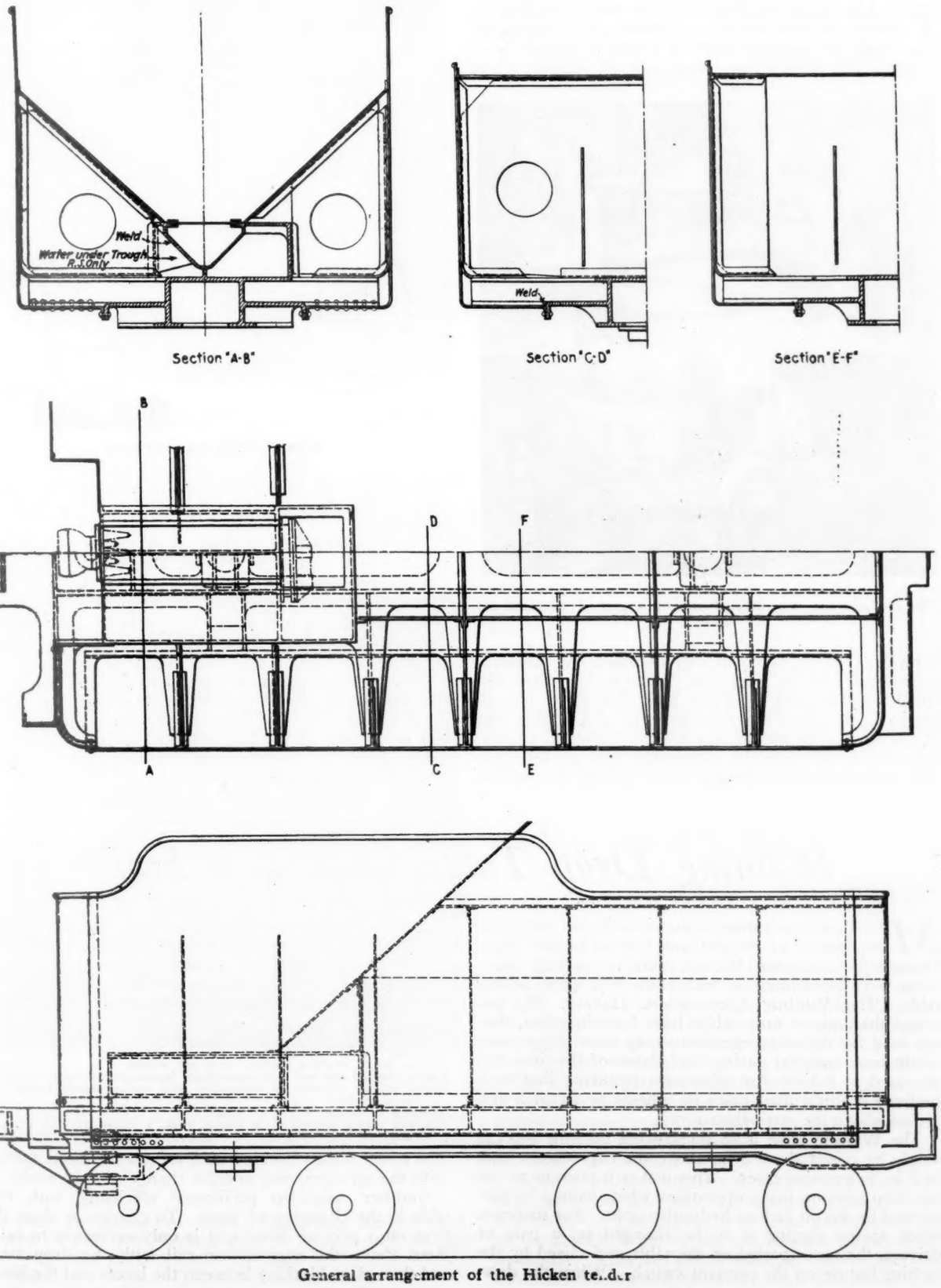
The same company has developed a conductor's valve for use on cabooses to meet the demand for more flexible control of brake-pipe reduction than is possible with the cut-out cock usually employed. This device is of the rotary valve type and has a port opening through the rotary valve from the brake pipe to atmosphere that varies from minimum to maximum as the handle is moved from left to right. A gradual opening of the brake-pipe connection can be obtained and any rate of reduction in the train line can be secured.

Hicken Tender with Increased Water Space

THE Baldwin Locomotive Works, Philadelphia, Pa., has patents pending on the Hicken design of locomotive tender, the purpose of which is to increase water capacity. The illustration shows the stoker compartment and stoker conveyor trough for the Standard stoker cast integral with the tender frame. The built-up center sill is replaced with a cast center sill with seven arms extending out from each side of the sill. As shown in Section *C-D*, the outer side sheets of the tender extend around the lower edge of the tender to the center-sill arms, to which the sheets are riveted and

welded together. This design eliminates the use of side sills and also reduces the number of seams through which water may leak.

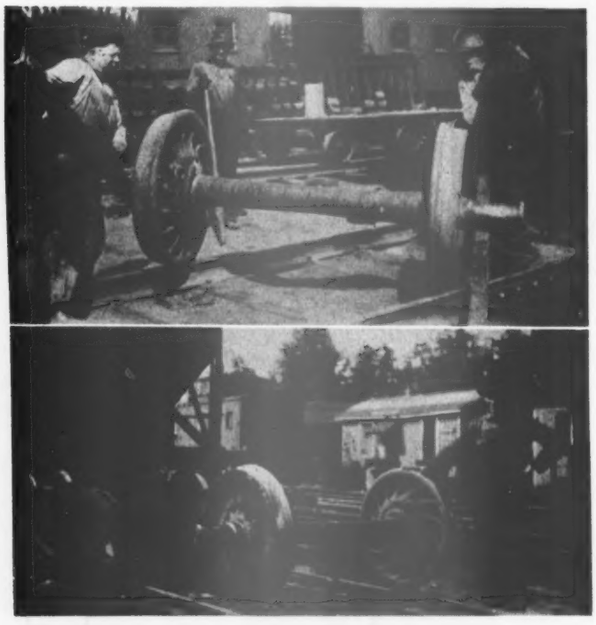
The advantages claimed for this design of tender are the elimination of rivets in the stoker compartment and the addition of about 600 gal. to water capacity.



General arrangement of the Hicken tender

Ball-Bearing Revolving Jack

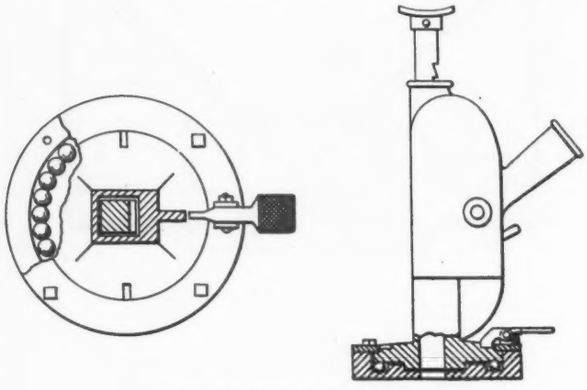
IN a car-repair yard in which no crane handling facilities are provided it is a difficult problem on the repair track to turn end for end a pair of mounted car wheels. To simplify this operation J. H. Hammack and



The old and the new way of turning a pair of mounted car wheels

John L. Gallion, foreman and assistant car foreman, respectively, of the Virginian, Victoria, Va., have patented a ball-bearing revolving jack. The upper part of the jack consists of any suitable form of a ratchet type of lift jack. The bottom is made into a special circular base which fits into the supporting base of the jack. The supporting base contains a row of ball bearings on which the jack proper revolves together with its load.

The supporting base and the base attached to the jack are held together by a retaining ring that fits into a recess cut in the top side of the jack base. This ring is held in place by bolts which pass through it into the supporting base. A rectangular hole is cut through the



How the jack is constructed

base, which acts as a guide for the shank of the lift so that it may move to its lowest position in the body of the jack.

The retaining ring is fitted with a pair of lugs between which a latch is pivoted. One end of the latch fits into recesses cut in the top surface of the jack base. The opposite end of the latch is a flat knurled surface which serves as a foot-pedal. The purpose of the latch is to prevent the jack from rotating in the supporting plate.

The parts are rigidly assembled so that all transverse stresses are equally distributed to the supporting plate. At the same time the jack may be readily rotated on the supporting plate. The bottom plate is made sufficiently large to fit over a tie and to provide the jack with a stable support.

Whiting Drop Table Used as a Hoist

MANY railroads have hesitated to install drop table equipment of the platform type at smaller points because they believed that not enough dropping operations were performed to realize the full value of the table. The Whiting Corporation, Harvey, Ill., has found that, where drop tables have been installed, they are used for dropping operations only about 50 per cent of the time and that during the balance of the time they are used as a hoist for operations requiring that locomotives or individual pairs of wheels be lifted a few inches above the enginehouse rail.

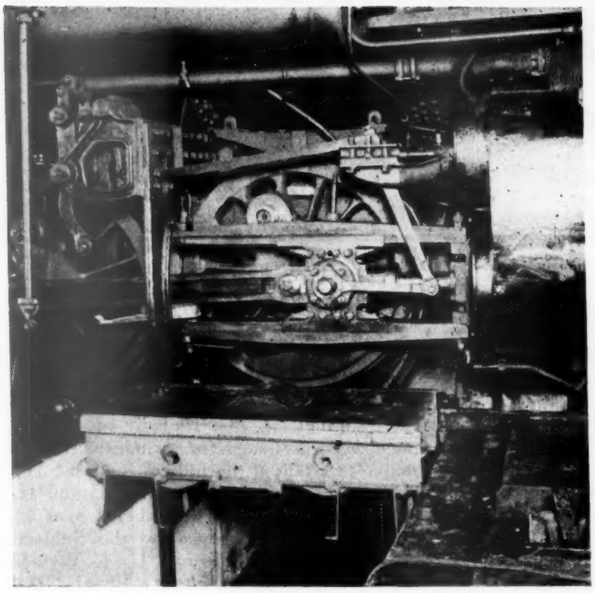
The Whiting table is so constructed that the top can safely be raised about 5 in. above the enginehouse rail, or 7 in. in extreme cases. This makes it possible to use the drop table on many operations which cannot be performed by the pit jack or hydraulic table. For instance, when spring rigging is to be changed on a pair of drivers, they are spotted on the table and raised by the inching button on the pendant switch. When the driving wheel is so elevated, it puts the driving spring rigging under a heavier compression, with the result that the spring equalizers shift positions accordingly.

While the wheel is in this position blocks can be placed between the equalizers and the locomotive frame.

Changing driving-wheel spring hangers
Changing driving-wheel spring rigging pins
Adjusting locomotives for height
Pushing up, or applying binders, shoes and wedges
Taking load off one end of locomotive for center casting work
Spring rigging changes on locomotive lead trucks, tender trucks and trailer trucks
Adjusting locomotive tender for height
Changing journal brasses in an engine truck, a tender truck or a trailer truck

The wheel is then lowered until it ceases to be in contact with the spring rigging and the changes can be made.

Another operation performed efficiently with this table is the changing of tires. To change or shim the tires on a pair of drivers, it is only necessary to raise them above the enginehouse rail with the drop table and then place blocking between the boxes and the bind-



Raising a No. 1 driving wheel preparatory to blocking the equalizer for the removal of the driver springs, pins or hangers

ers. Lowering the table to its normal position leaves the wheels free for tire removal.

These are only two of the many jobs in which this type of table may be used as a hoist. Some of the others are listed in the table.

A driving wheel raised above the rail for removal of the tire

A 50-ton table of this type will safely hoist a load of 80 tons. Some shops have lifted 100 tons with a 50-ton table, but this is not advisable.

HIGH SPEED SNAGGING.—Brief descriptions of complete equipment for high speed snagging are given in the 16-page catalogue recently issued by the Norton Company, located at Worcester, Mass.

Shimming Device for a Dalman Truck

THE illustration shows a shimming device designed by the Standard Car Truck Company, Chicago, for use with the Barber lateral motion device in order to raise the height of the truck bolster of the two-level Dalman truck when the drawbar has become too low.

With the lateral-motion device, the truck bolsters are provided with the contours for receiving the lateral motion rollers. In shimming up, this roller cap makes a new contour on the bolster for the rollers and the back of the shim fits the old contours in the bolster.

Shim used for raising the bolster of a two-level Dalman truck

The shim is of drop-forged steel and forms a roller cap that slips into place and is securely held for displacement, the one piece taking the place of four pieces required in other methods of shimming. The shims can be furnished in different thicknesses.

New Features of Starrett Micrometers

THE L. S. Starrett Company, Athol, Mass., has added to its line of micrometers, with the exception of Nos. 238 and 239, half thousandths divisions on the thimble. Starrett micrometers, No. 436, may now be had with the lock-nut feature. A knurled locking not contracting a split bushing around the spindle tightens and keeps the spindle central and true, or by a slight turn locks it firmly, making a solid gage when desired.

The No. 440 Starrett micrometer depth gage can now be furnished with a ratchet stop, which permits the same degree of pressure at the point of contact in measuring, which assures a more accurate reading by eliminating the chance of unequal "feel."

Another feature which will be useful to instructors and apprentices and may be desired by some mechanics is micrometer graduations where the intermediate lines on the thimble denoting thousandths are numbered consecutively. This method of marking may be had on all Starrett micrometers, excepting Nos. 238 and 239.

News of the Month

THE PENNSYLVANIA has placed orders for 4000 steel box car bodies to cost approximately $6,400,000.

FIRE IN A CAR SHOP of the Great Northern at Great Falls, Mont., on June 10, destroyed the building, a one-story structure, and about 40 cars in the process of repair.

MECHANICAL DEPARTMENT FORCES of the Louisville & Nashville and clerks of the Chicago & Alton have been granted wage increases, effective July 1. The increases on the Louisville & Nashville, which range from 3 to 5 cents an hour, affect nearly 10,000 employees and involve an increase in the annual payroll of about $1,000,000.

Supplement No. 1 to Current Rules of Interchange

According to Circular No. D. V. 651, issued July 20 from the office of the Secretary of the A. R. A., Supplement No. 1 to the current Rules of Interchange has been prepared by the Arbitration Committee and the Committee on Prices for Labor and Materials which includes new Rules 61 and 83, additional provisions in Rules 26, 91 and 98, extension of effective dates of various provisions of Rules 3, 66 and 80, and revisions of Rules 3, 7, 17, 59, 81, 101, 107, 108, 111 and 112, and Passenger Rules 7, 21 and 22.

This supplement will be forwarded immediately to all purchasers of the original book in the same number as furnished, without additional charge or the necessity of making requisition to cover.

Clubs and Associations

Fall Meeting of the American Welding Society

The papers to be presented by the American Welding Society as its part of the National Metal Congress to be held in Cleveland, Ohio, during the week of September 9 are as follows:

Non-destructive Tests of Welds, by Elmer A. Sperry Development Company.
X-Ray Investigation on Welds, by Dr. H. H. Lester, Watertown Arsenal.
Oxyacetylene Welding of Pipe Lines in the Field, by W. R. Ost, Air Reduction Sales Company.
Welding of Pipe Lines, by H. C. Price, manager, Welding Engineering Company, Bartlesville, Okla.
A Metallographic Study of Some Metallic Arc Welds, by Prof. H. M. Boylston, Case School of Applied Science, Cleveland.
Welding of Copper and Copper Alloys, by Mr. Hook, Research Laboratory, American Brass Company.
Welded High Strength Aluminum Alloys for the Aircraft Industry, by Mr. Dawson, Research Laboratory, Linde Air Products Company.
Foreign Practice in Welding of Boilers, Tubes and Drums, by G. A. Orrik, Consulting engineer, New York.
Stress-Strain Characteristics of Welded Joints, by Prof. J. H. Smith, University of Pittsburgh.
Study of Nitroid Needles, by P. Alexander, General Electric Company.
Cutting and Welding Steel Parts To Replace Castings, by W. J. Buchanan, The Bessemer Gas Engine Company, Grove City, Pa.
Testing Equipment Used in Welding Industry, by V. G. Tatnall, Southwark Foundry & Machine Company.
Machinery Design as Influenced by Electric Welding, by H. G. Boist, General Electric Co.

The Iron and Steel Division of the Mining and Metallurgical Engineers, the Iron and Steel Division of the American Society of Mechanical Engineers, the Institute of Metals and the American Society for Steel Treating will have conventions in Cleveland during the same week.

During the National Metal Congress the National Metal Exposition will be held, over 10,000 sq. ft. being devoted to exhibits of welding and cutting equipment and supplies.

M. C. B. & S. Association Convention Program

During the past year the newly-organized Master Car Builders' and Supervisors' Association has made notable progress under the leadership of President S. O. Taylor, master car builder, Missouri Pacific, St. Louis, Mo., and Secretary A. S. Sternberg, master car builder, Belt Railway of Chicago, Chicago, and plans have been perfected for an unusually well-balanced and constructive program at the fall convention. This meeting, the first annual convention of the new association, will be held at the Hotel Sherman, Chicago, September 4 to 6, inclusive. Details of the program developed by the Subjects Committee under the direction of Chairman C. J. Wymer, superintendent car department, Chicago & Eastern Illinois, Danville, Ill. and first vice-president of the association, are.

First Session—Wednesday, September 4

10:00 a.m. Meeting called to order.
Invocation by B. F. Jamison, special traveling auditor, Southern, Meridian, Miss.
Address by President S. O. Taylor, master car builder, Missouri Pacific, St. Louis, Mo.
10:30 a.m. Report by Secretary A. S. Sternberg, master car builder, Belt Ry. of Chicago.
10:45 a.m. Address by R. H. Aishton, president, American Railway Association.
11:15 a.m. Address by T. W. Demarest, general superintendent of motive power, Pennsylvania, Western Region, Chicago.
11:45 a.m. Individual paper on High Frequency Car Shop Tools and Machinery, by C. D. Coates, electrical engineer, Chicago Pneumatic Tool Company, Cleveland, Ohio.
12:30 p.m. Adjournment.

Second Session

2:00 p.m. Report of Advertising Committee—Chairman H. A. Sigwart, supervisor car repair bills, Missouri Pacific Railroad, St. Louis, Mo.
2:10 p.m. Report of Membership Committee—Chairman K. F. Nystrom, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis.
2:20 p.m. Report of Committee on Reclamation—Chairman G. W. Lieber, superintendent of reclamation, Missouri-Kansas-Texas, Parsons, Kans.
3:00 p.m. Report of Committee on Elimination of Oil and Grease Spots from Floors of Box Cars for High-Class Commodities—Chairman W. T. Westall, district master car builder, New York Central, Collinwood, Ohio.
4:00 p.m. Report of Committee to Formulate Uniform Methods for Education, Examination and Selection of Car Inspectors—Chairman F. E. Cheshire, general car inspector, Missouri Pacific, St. Louis, Mo.
5:00 p.m. Adjournment.

First Session—Thursday, September 5

9:00 a.m. Report of Committee on Proper Maintenance of Tank Car Equipment and Its Effect on Increasing Car Mileage—Chairman C. H. McBurney, master car builder, Transcontinental Oil Company, Tulsa, Okla.
9:30 a.m. Report of Committee on Proper Loading of Cars—Chairman C. J. Nelson, chief interchange inspector, Chicago.
10:15 a.m. Report on Methods of Loading Automobiles to Minimize Damage to Floors of Automobile Cars—Chairman M. J. Mills, master car builder, Pere Marquette, Detroit, Mich.
11:15 a.m. Report of Committee on Renovation, Fumigation and Disinfection of Passenger Equipment—Chairman W. J. McClennan, general shop inspector, New York Central, New York City.
12:00 Adjournment.

Second Session

2:00 p.m. Address on Psychological Aspects of Handling Men, by Doctor S. N. Stevens, Northwestern University, Chicago.
2:45 p.m. General discussion on rebuilt cars—Opened by W. J. McClennan, general shop inspector, New York Central, New York City.
3:15 p.m. General discussion on improved wheel shop practices—Opened by J. Matthes, Jr., chief car inspector, Wabash, Decatur.
3:45 p.m. Adjournment to view exhibits.

First Session—Friday, September 6

9:00 a.m. Report of A.R.A. Committee—Chairman M. E. Fitzgerald, general car inspector, Chicago & Eastern Illinois, Danville, Ill.
Report of A.R.A. Billing Section Committee—Chairman E. S. Swift, chief A.R.A. clerk, Wabash, Decatur, Ill.
Discussion and interpretation of A.R.A. interchange rules.
12:00 Adjournment.

Second Session

2:00 p.m. Continuation of discussion of A.R.A. rules.
3:30 p.m. Report of Nominating Committee—Chairman S. O. Taylor, master car builder, Missouri Pacific, St. Louis, Mo.
3:40 p.m. Election of officers.
4:00 p.m. Report of Committee on Memorials and Courtesies—Chairman T. J. O'Donnell, chief interchange inspector, Niagara Frontier, Buffalo, N. Y.

The following list gives name of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—T. L. Burton, Roome 5605 Grand Central Terminal building, New York.

AMERICAN RAILWAY ASSOCIATION DIVISION V—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting, Muehlebach Hotel, Kansas City, Mo., September 10-12.

DIVISION VI—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago. Next meeting, September 11-14, 1929, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid Ave., Cleveland, Ohio. Annual Convention, September 9-13, Cleveland, O.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting Hotel Sherman, Chicago, October 22-25.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Windsor Hotel, Monteal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 7836 So. Morgan street, Chicago, Ill. Regular meeting second Monday in each month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—F. G. Wiegman, 720 North Twenty-third street, East St. Louis, Mo. Regular meeting first Tuesday in each month, except June, July and August, at Broadview Hotel, East St. Louis, Ill.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meetings second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—Regular meetings second Tuesday each month, except June, July and August, at Hotel Statler, Buffalo.

CHIEF INTERCHANGE CAR INSPECTORS AND CAR FOREMEN'S ASSOCIATION.—See Master Car Builders' and Supervisors' Ass'n.

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 3328 Beekman St., Cincinnati. Regular meeting second Tuesday, February, May, September and November.

CLEVELAND RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month, except July, August and September at Hotel Hollenden, East Sixth and Superior Ave.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting, August 20-22, 1929, Fort Shelby Hotel, Detroit.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—L. G. Plant, Railway Exchange, 80 E. Jackson Boulevard, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash street, Winona, Minn. Convention September 17-20, inclusive.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, 3212 Delachaise street, New Orleans, La. Meetings third Thursday in each month.

MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago, Chicago. Annual convention, September 4, 5 and 6 at the Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September, Copley-Plaza Hotel, Boston.

NEW YORK RAILROAD CLUB.—Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Tuesday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CAR DEPARTMENT OFFICER'S ASSOCIATION.—See Master Car Builders' and Supervisors' Association.

RAILWAY CLUB OF GREENVILLE.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meetings third Thursday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, M. P. O. Drawer 24, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.

SOUTHWEST MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—See Master Car Builders' & Supervisors' Association.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 24-28, Hotel Sherman, Chicago.

WESTERN RAILWAY CLUB.—W. J. Dickinson, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

"THREADING SPECIALIZED."—This is the title of the 20-page booklet issued by the Landis Machine Company, Waynesboro, Pa., describing Landis die heads, pipe threading and cutting-off machines, staybolt threading machines, pipe and nipple threading machines, automatic forming and threading machines and Victor collapsible taps. After each description there is a photograph of the machine in operation, also data regarding the threads being cut on the machine.

Supply Trade Notes

THE INTERSTATE IRON & STEEL COMPANY, Chicago, has moved its Detroit, Mich., office to the General Motors building.

R. W. PROCTER, formerly of the Black & Decker Manufacturing Company, has been appointed general sales manager of the Van Dorn Electric Tool Company, Cleveland, Ohio.

THE AMERICAN HOIST & DERRICK COMPANY, St. Paul, Minn., has moved its office at San Francisco, Cal., to 5515 Doyle avenue, Oakland, Cal. Boyd Nixon, who was in charge of the San Francisco office is in charge of the Oakland office.

JOHN R. GUINN has been appointed representative in New York and New England territory of the Standard Steel Works Company, Philadelphia, Pa. Mr. Guinn's headquarters are at 120 Broadway, New York City.

J. E. BUCKINGHAM, formerly district manager of the railroad division of the Worthington Pump & Machinery Corporation, with headquarters at St. Louis, Mo., has been appointed acting manager of that division, with headquarters at Harrison, N. J. Mr. Buckingham will succeed D. R. Coleman who has been granted a six months leave of absence.

THE FUSION WELDING CORPORATION is now owned outright by the Chicago Steel & Wire Company. One Hunder Third street and Torrence avenue, Chicago. The same personnel is in charge. The Fusion Welding Corporation has taken over the sale of all welding rod manufactured by the parent company, thus providing one source of supply for welding equipment and accessories previously sold by the two companies.

GEORGE L. COTTER, assistant to the general manager of the Westinghouse Air Brake Company, has been appointed engineer of the Pittsburgh district, with headquarters at Wilmerding, Pa. Charles H. Parr, who had been engaged in field work in connection with train-control equipment, is now engineer of the Southeastern district, with headquarters at Washington, D. C.

THE AMERICAN HOIST & DERRICK COMPANY, St. Paul, Minn., has opened a branch office and warehouse at 337 South Anderson street, Los Angeles, Cal. W. H. Lummus, who has represented the company on the west coast for many years, is in charge of the Los Angeles office. W. M. Cusac, formerly with the McMyler Interstate Company, Cleveland, Ohio, has joined the Chicago sales force of the American Hoist & Derrick Company.

A RECENT REORGANIZATION of the sales organization of the Johns-Manville Corporation, New York, has enlarged the activities of the general railroad and government department to include the aviation industry. This branch of the corporation's activities will in the future be known as the transportation and government department, intended ultimately to cover all forms of transportation. The department will continue to function under the control of George A. Nicol, Jr., vice-president.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has reorganized its railway engineering department which in future will be known as the transportation engineering department. H. L. Andrews is now engineer of the department; W. B. Potter has been appointed consulting engineer, with A. H. Armstrong and W. J. Davis, Jr., as associates and consulting engineers. Included in and as divisions of the transportation engineering department will be the railway equipment, the air-

brake equipment and the industrial locomotive engineering departments at the Erie, Pa. works, and the automotive engineering department at the Lynn, Mass., river works.

R. C. BROWN, general manager of the Timken Roller Bearing Service and Sales Company at Canton, Ohio, has been appointed assistant secretary and assistant treasurer of the Timken Roller Bearing Company and is succeeded by W. H. Richardson, manager of the New York branch of the Service and Sales Company. E. H. Austin, manager of the Kansas City, Mo., branch, succeeds Mr. Richardson and in turn is succeeded by J. L. Halderman, manager of the Atlanta, Ga., branch. Parker T. Ancarrow, manager of the Richmond, Va., branch has been transferred to Atlanta and is succeeded by Stewart B. Ancarrow.

A SUIT by the Cleveland Crane & Engineering Company against the Reading Chain & Block Corporation for alleged patent infringement was recently dismissed by the U. S. District Court of Eastern Pennsylvania in a decision handed down by Judge W. H. Kirkpatrick. The suit involved the use of a rigid member or pipe extending downward from the crane trolley and used as a conduit for wiring between the push button control and the trolley and also as a means for propelling the crane by hand. The plaintiff claimed infringement of one of its patents when the defendant employed this arrangement in the manufacture of its hand cranes. The defendant claimed invalidity because of prior use of the particular device referred to, and the court dismissed the suit on that ground.

THE YALE & TOWNE MANUFACTURING COMPANY, Stamford, Conn., has contracted to purchase the assets and goodwill of the Stuebing Cowan Company, Cincinnati, Ohio, and Holyoke, Mass., makers of hand lift trucks. The sales of the Yale & Towne entire line of material handling devices will continue to be under the supervision of James C. Morgan, and arrangements have been made under which the executive personnel of the Stuebing Cowan Company will enter the services of the Yale & Towne Company. Walter C. Stuebing will act as assistant to Mr. Morgan, in charge of all truck sales, and William Stuebing will continue to act as superintendent of the plant in Cincinnati. A large modern factory for the manufacture of hand lift trucks and skid platforms is in process of construction in Cincinnati.

JOHN S. TURNER, who served for the past 25 years in the sales department of the Pressed Steel Car Company, died on July 15. Mr. Turner was born at Reading, Pa., on March 9, 1859. He entered the employ of the Cumberland & Pennsylvania as a machinist apprentice in September, 1875, and four years later went to the Altoona shops of the Pennsylvania where he worked in various capacities until January, 1884, when he was appointed assistant road foreman of engines. The following November he went to the Mexican Central (now part of the National Railways of Mexico) as master mechanic. In February, 1887, he entered the service of the New York Air Brake Company as special representative and spent two years in Spain supervising application of vacuum brakes. He returned to the Mexican Central in November, 1891, as master mechanic. One year later he entered the employ of the Mexican International (now part of the National Railways of Mexico) as assistant superintendent of motive power. In April, 1894, he became superintendent of motive power of the West Virginia Central & Pittsburgh (now part of the Western Maryland) and subsequently served in the same capacity successively on the Colorado & Southern, and the Fitchburg Railroad (now part of the Boston & Maine). He was then appointed superintendent of motive power and equipment of the Toledo, St. Louis & Western (now part of the New York, Chicago & St. Louis. Mr. Turner entered the employ of the Standard Coupler Company in December, 1901, as special representative. He had served in the sales department of the Pressed Steel Car Company since September 15, 1904.

F. A. MERRICK, vice-president and general manager of the Westinghouse Electric & Manufacturing Company has been elected president, with headquarters at Pittsburgh, Pa., and J. S. Tritle, in charge of manufacturing operations, has been elected a vice-president with headquarters at East Pittsburgh. In announcing the election of Mr. Merrick to the presidency of the company, A. W. Robertson, chairman, stated that the board of directors in accepting the resignation of E. M. Herr, president since 1911, in order that he might go on an extended vacation, had elected him vice-chairman.

F. A. Merrick

F. A. Merrick was born in New Jersey and received his technical education at Lehigh University. Shortly after his graduation he was employed by the Steel Motors Company, a subsidiary of the Lorain Steel Company, where he was responsible for many important electrical inventions and where he held the position of manager and chief engineer. On the acquisition of the Steel Motors Company by the Westinghouse Company, Mr. Merrick entered the Westinghouse organization. He was selected to prepare plans for a plant in Canada and, upon the formation of the Canadian Westinghouse Company, Ltd., in 1903, was appointed superintendent of the Canadian company. He was then successively manager of works and later vice-president and general manager of the Canadian Westinghouse Company, Limited.

During the World War, Mr. Merrick was assigned to organize the operations of the New England Westinghouse Company, located in Chicopee Falls, Mass., to manufacture rifles for the Russian government and, when the United States entered the war, to supply war material for the American government.

Mr. Merrick, although required to reorganize and largely re-equip this factory to fulfill American war contracts, completed an order for 60,000 Browning machine guns within 11 months after operations were begun. After the war, Mr. Merrick was located in London, England, for two years as special representative of the Westinghouse Electric International Company, after which he returned to Canada to resume his duties as vice-president and general manager of the Canadian Westinghouse Company, Ltd.

In January, 1925, he became vice-president and general manager of the Westinghouse Electric & Manufacturing Company, with headquarters at East Pittsburgh, Pa. In June, 1925, he was also elected a director of the company.

Edwin M. Herr, the new vice-chairman, was born in Lancaster, Pa., on May 3, 1860, and after attending public schools he served as telegraph operator on the Kansas Pacific (now a part of the Union Pacific) and later became station agent. In 1881 he entered the Sheffield Scientific School of Yale University and was graduated in 1884. He subsequently served in the office of the mechanical engineer of the Chicago, Burlington & Quincy at Aurora, Ill., and then as a mechanical draftsman, later becoming successively engineer of tests, superintendent of telegraph and finally division superintendent of that road. In 1891 he was appointed division master mechanic of the Chicago, Milwaukee & St. Paul and two years later went to the Grant Locomotive Works as general superintendent at Chicago.

In 1894 he became general manager of the Gibbs Electric Company of Milwaukee and on the dissolution of this company shortly thereafter, Mr. Herr visited Europe in order to inform himself of foreign railroad practice. On his return to America he went back to railroading and in 1895 was appointed assistant superintendent of motive power of the Chicago & North West-

ern and, one year later, superintendent of motive power of the Northern Pacific.

In 1898 he became general manager of the Westinghouse Air Brake Company, at Wilmerding, Pa., remaining with that company until 1905 when he was elected first vice-president of the Westinghouse Electric & Manufacturing Company. When this company entered a receivership in 1907 Mr. Herr served as one of the receivers and general manager. About a year later when the company was reorganized, he resumed his former position with the company and in 1911 was elected president. During a visit to Japan in 1920, Mr. Herr was decorated by the Emperor of Japan with the Order of the Rising Sun in acknowledgment of his co-operation in training Japanese students at the Works of the Westinghouse Company. Mr. Herr has always been interested in educational matters and has devoted much of his time to developing an educational system for employees of the company. He is a member of the Yale (University) Corporation and of the committee in charge of finance of that institution. He is a director of the American Manufacturers' Export Association, Radio Corporation of America, Westinghouse Air Brake Company, Westinghouse Electric & Manufacturing Company and various other organizations.

JOHN SUMNER RUNNELLS, three months after his retirement as chairman of the board of directors of the Pullman Company, died at his summer home at Chocura, N. H., on July 11, in his eighty-fifth year. Mr. Runnells' death followed a day's illness. Except for a paralytic stroke several years ago, he had recently enjoyed good health.

J. S. Runnells

In the succession of presidents of the Pullman Company Mr. Runnells followed Robert T. Lincoln, when he became chairman of the board, in 1911 and preceded Edward F. Carry, when Mr. Runnells succeeded to the chairmanship in 1922. He was perhaps the last officer of the operating unit of Pullman who was closely allied with the founder, George M. Pullman, and who knew intimately his ideas and plans for the future of the company. As general counsel for 11 years before Mr. Pullman's death in 1898 he served as his personal legal advisor.

During Mr. Runnells' incumbency as president, the activities of the operating unit of Pullman experienced a decided expansion. While there was no appreciable difference in the mileage of railways covered by contracts for operating cars, this figure varying from about 215,000 to about 220,000 miles, there was an increase in other operating indicators. The total number of cars owned and controlled increased from 5,912 in 1911 to 7,674 in 1922.

Mr. Runnells was born on July 30, 1844, at Effingham, N. H., and graduated from Amherst College in 1865. Shortly after that time he moved to Iowa where he served for two years as private secretary to the governor of the state. This launched him on a public and legal career which included the positions of consul at Tunstall, England, from 1869 to 1871, reporter for the Iowa supreme court from 1875 to 1881 and United States district attorney for Iowa from 1881 to 1885. He was admitted to the bar in 1871 and practiced law at Des Moines, Iowa, from that date until 1887.

In the latter year he became general counsel for the Pullman Palace Car Company at Chicago, the former name of the Pullman Company. In 1905 he was elected vice-president; in 1911 elected president, and in 1922 appointed chairman of the board.

W. R. CARNEGIE, vice-president and general manager of Berry Brothers, Inc., Detroit, Mich., has been elected president and general manager. Mr. Carnegie joined the organization in 1895. He was treasurer for 25 years before taking up his present duties as general manager. F. L. Colby, who was president, has been promoted to chairman of the board of directors. John C. Witherspoon, for many years a member of the board of directors, has been elected vice-president. The board has been increased two members, H. L. Stanton, and Joseph Berry Sherrard, grandson of Joseph H. Berry, one of the founders, are the new members.

J. E. FORSYTH, who has been elected president of the Forsyth Draft Gear Corporation, Chicago, has been engaged in the railway supply field for 42 years. He was born in 1852 at Jackson Center, Ohio, and at the age of 18 started to learn the jeweler's trade. In 1879 he entered the furniture business with his father at Sidney, Ohio. In 1887 Mr. Forsyth organized the Hinson Car Coupler Company (now part of the Harrison Steel Casting Company) at Des Moines, Iowa, moving the company to Chicago in the following year. He organized the Forsyth Automatic Connector Company, of which he is president, in 1902. In 1927 Mr. Forsyth organized the Forsyth Draft Gear Corporation, serving as consulting engineer until his recent election to president.

J. E. Forsyth

C. E. POSTLETHWAITE, general sales manager of the Pressed Steel Car Company, has been appointed assistant vice-president, with headquarters at New York, and F. O. Schramm, assistant general sales manager, has been appointed general sales manager, eastern district, with headquarters at New York. Mr. Postlethwaite served on the Pennsylvania from 1883 to 1890 successively as a rodman in an engineering corps, telegraph operator and car clerk on the Pennsylvania Railroad division. From 1890 to 1897 he was with the Norfolk & Western as chief clerk to the general superintendent. He entered the service of the Schoen Pressed Steel Car Company in 1897. The Schoen Company was later merged with the Pressed Steel Car Company. Mr. Postlethwaite was appointed general sales manager of the Pressed Steel Car Company in December, 1915. Mr. Schramm was born at Chicago, Ill., on October 25, 1891. He entered the service of the Western Steel Car & Foundry Company, a subsidiary of the Pressed Steel Car Company, at Chicago, on June 1, 1907, as stenographer in the operating department. Mr. Schramm continued in the service in various capacities in the operating and sales departments at the Hegewisch plant and in the Chicago office until January 1, 1917, when he was transferred to the New York office of the Pressed Steel Car Company. He was appointed assistant secretary on March 1, 1921, and assistant general sales manager, eastern district, in February, 1928. Mr. Schramm in becoming general sales manager, eastern district, retains also the duties of assistant secretary.

ROBBINS & MYERS, INC., Springfield, Ohio, has organized a new hoist and crane division. The executive, technical and sales personnel of this division were all formerly associated with the Chisholm-Moore Manufacturing Company in Cleveland, in similar capacities. Frank F. Seaman is general manager of the division; Carl E. Schirmer is chief engineer; John R. Mears is in charge of sales; Albert Kreh, William J. Scott and John J. Becker are district sales managers for New York, Chicago and Detroit, respectively. The Robbins & Myers hoists, cranes and trolleys will include both hand and electric power up to 10-tons capacity.

Personal Mention

General

W. B. GRAHAM, mechanical inspector of the Missouri Pacific, has been appointed superintendent of motive power, with headquarters at Palestine, Tex.

E. B. HALL has been appointed general superintendent of motive power and machinery of the Chicago, St. Paul, Minneapolis & Omaha, with headquarters at Chicago, Ill., and St. Paul, Minn.

GEORGE MCCORMICK, general superintendent of motive power of the Southern Pacific, with headquarters at San Francisco, Cal., has also been appointed general superintendent of motive power of the Northwestern Pacific.

WILLIAM G. BLACK, mechanical assistant to the president of the Erie at Cleveland, Ohio, has been appointed mechanical assistant to the president of the Chesapeake & Ohio with headquarters at the same city.

R. H. FLINN, superintendent of motive power of the Western Pennsylvania division of the Pennsylvania at Pittsburgh, Pa., has been promoted to general superintendent of motive power of the Central region, with headquarters at the same point, succeeding O. P. Reese.

Shop and Enginehouse

W. J. WITHERS has been appointed machine shop foreman, locomotive department, of the Missouri Pacific, with headquarters at Palestine, Tex.

S. P. BYRNES, federal inspector of the Missouri Pacific at Palestine, Tex., has been promoted to the position of erecting shop foreman, with headquarters at Palestine.

F. W. STEVENS, general car foreman of the Missouri-Kansas-Texas at San Antonio, Tex., has been appointed assistant shop superintendent, with headquarters at Sedalia, Mo.

A. M. FIREBAUGH, night enginehouse foreman of the Missouri Pacific at Palestine, Tex., has been appointed federal inspector, with headquarters at Palestine.

Master Mechanics and Road Foremen

E. L. BACHMAN, master mechanic of the Buffalo division of the Pennsylvania, has been transferred to Harrisburg, Pa.

THE HEADQUARTERS of T. A. Roussin, master mechanic of the Missouri-Illinois, have been removed from Sparta, Ill., to Bonne Terre, Mo.

FRED W. OAKLEY, master mechanic of the Louisville & Nashville at Ravenna, Ky., has been transferred to Corbin, Ky., succeeding Harry Feather, deceased.

P. M. SULLIVAN, traveling engineer of the Duluth, Missabe & Northern, has been appointed master mechanic, with headquarters at Proctor, Minn., succeeding W. J. Greene, deceased.

W. M. JOHNSON, assistant foreman at the Nashville (Tenn.) shops of the Nashville, Chattanooga & St. Louis, has been promoted to master mechanic of the Chattanooga division and the Chattanooga terminal, with headquarters at Chattanooga, Tenn., succeeding A. J. Law, deceased.

R. R. SPANGER has been appointed road foreman of engines of the Portland Division of the Southern Pacific, Pacific Lines, with headquarters at Eugene, Ore.

J. E. NORRIS, master mechanic of the Los Angeles division of the Los Angeles & Salt Lake, has been transferred to the Salt Lake division to replace G. R. Wilcox.

HARVEY E. GREEN, has been appointed acting road foreman of the Northern Pacific at Northtown, Minn., succeeding C. W. Extrand, who has been granted a leave of absence.

J. A. MARSHALL, master mechanic of the Northern Pacific at Pasco, Wash., has been transferred as master mechanic to Glendive, Mont., succeeding J. W. Matheson, retired.

MARTIN F. BROWN, fuel supervisor of the Northern Pacific at Seattle, Wash., has been promoted to the position of road foreman, with headquarters at Missoula, Mont., succeeding L. J. Gallagher.

GEORGE L. ERNSTROM, assistant master mechanic of the Northern Pacific at Staples, Minn., has been appointed master mechanic, with headquarters at Pasco, Wash., succeeding J. A. Marshall.

G. S. WEST, master mechanic of the Conemaugh division of the Pennsylvania, has been transferred to the Buffalo division, with headquarters at Olean, N. Y. Mr. West replaced E. L. Bachman.

LUKE J. GALLAGHER, road foreman of the Northern Pacific at Missoula, Mont., has been promoted to the position of assistant master mechanic, with headquarters at Staples, Minn., succeeding G. L. Ernstrom.

C. O. SHULL, assistant master mechanic of the Eastern region of the Pennsylvania at Altoona, Pa., has been promoted to master mechanic of the Conemaugh division, with headquarters at Sharpsburg, Pa., succeeding G. S. West.

G. R. WILCOX, master mechanic of the Salt Lake division of the Los Angeles & Salt Lake, with headquarters at Milford, Utah, has been transferred to the Los Angeles division, with headquarters at Las Vegas, Nev., succeeding J. E. Norris.

KEPLER JOHNSON, superintendent of the Oklahoma-Southern division of the Chicago, Rock Island & Pacific, with headquarters at Fort Worth, Tex., has also been appointed superintendent and master mechanic of the Oklahoma-Southern division of the Chicago, Rock Island & Gulf.

Car Department

R. C. REESE, car foreman of the Missouri-Kansas-Texas at Denison, Tex., has been transferred to San Antonio, Tex.

C. C. LITTLE has been appointed car foreman of the Union Pacific, with headquarters at Spokane, Wash.

L. R. CENTER, car foreman of the Missouri-Kansas-Texas at San Antonio, Tex., has been appointed general car foreman, with headquarters at San Antonio, succeeding F. W. Stevens.

GEORGE F. SHEARMAN, assistant general car foreman, has been promoted to the position of general car foreman of the Chicago Junction and the Chicago, Rock Island & Pacific.